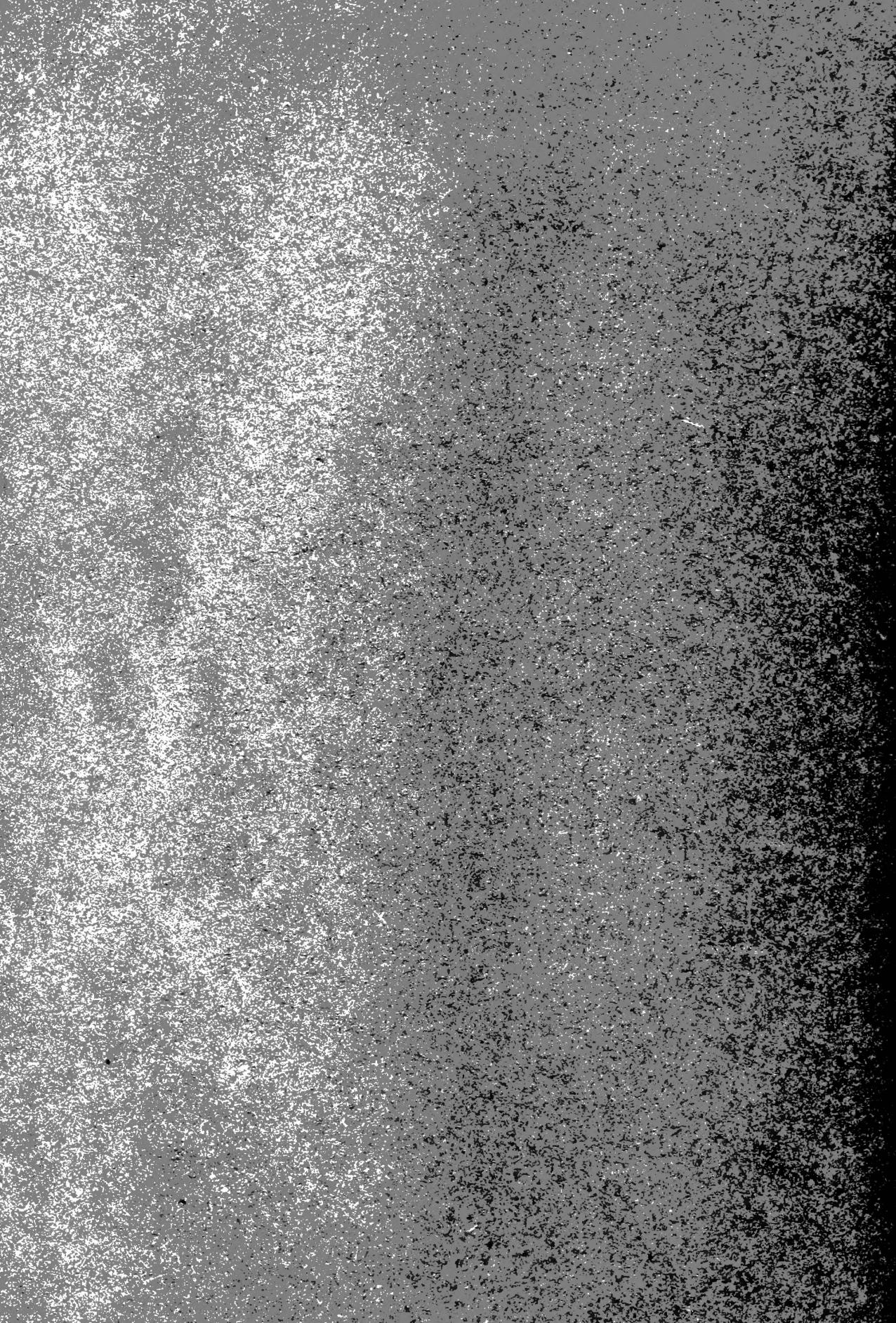


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FOREST SERVICE

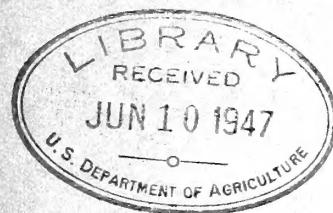
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# FOREST RESEARCH ACTIVITIES

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FOREST MANAGEMENT  
RANGE MANAGEMENT  
FOREST PRODUCTS

FOREST ECONOMICS  
FOREST SURVEY  
FOREST INFLUENCES



JUN 1940





FOREST RESEARCH

BI-MONTHLY REPORT

June 1, 1940



FOREST RESEARCH

BI-MONTHLY REPORT

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## GENERAL

### Allegheny

Personnel. McClenen was transferred to the Standing Stone Experimental Forest in April. Turberville left for a permanent job and has been replaced by Ralston.

Tionesta Natural Area. Agreement, on the basic principles of management to be followed on this tract, was reached by the Forest Service and a committee of the Pennsylvania Forestry Association. The report recommending establishment of a natural and scenic area is being sent to Washington for signature.

Cooperation. In cooperation with the Soil Conservation Service a marketing survey was conducted in Baltimore and Harford Counties, Maryland, for the use of the farm forestry project which is now underway. Approximately 100 sawmills and industries using farm forest products were visited on this survey. Information concerning the amount, species, specifications, prices paid, and place obtained, was secured insofar as possible. A similar survey has been started in Adams County, Pennsylvania.

T. D. Stovens, a Yale graduate student who had studied forest succession on upland soils in the Barrens, brought down his collection of plants to add to the Station's working herbarium.

Haig and Shirley spent one day at the Lebanon Experimental Forest discussing the problems of New Jersey with Moore, Scidol, and Waldron, from the State Department of Conservation and Development, and Little of the Station. In general, the discussion covered problems in forest economics, fire protection, and silviculture—particularly those of importance in the Pine Barrens, New Jersey's problem area. Shirley also spent a week in northwestern Pennsylvania examining harvest cutting operations on the Armstrong Forest Company lands and the Allegheny National Forest.

### Appalachian

Visitors. Doan Emeritus Henry S. Graves of the Yale School of Forestry, accompanied by Mr. Hillis L. Howie, visited the Station in the course of his investigations of the problems of education and research in forestry in the southern states. This work is being done under an assignment from the General Education Board of New York.

Forest school students from Louisiana State, Michigan and North Carolina State Universities made field trips through different

parts of the Station's territory.

Personnel. The following personnel changes have taken place in the Asheville office of Forest Insect Investigations: Hoffmann was transferred to this Station from the Morristown, N. J., laboratory, Baker went to a new laboratory at Columbus, Ohio, to work on insects in relation to the elm "phloem necrosis" disease; and Kowal was transferred to the Morristown laboratory.

California

Northern Redwood Experimental Forest. Substantial progress has been made toward the establishment of a Redwood Experimental Forest in the northern one of the two redwood purchase units approved by the National Forest Reservation Commission. The High Prairie Creek area was tentatively selected as the most desirable location for an experimental forest which would represent northern redwood conditions. After the purchase of lands began in 1939, a more detailed examination of this and adjoining areas confirmed the desirability of the High Prairie Creek area. On January 15, 1940, the designation of this drainage as the first Redwood Experimental Forest was approved by representatives from the Experiment Station and the Regional Office. A more detailed report was then completed and has now been submitted for formal approval by the Regional Forester and the Washington office.

The High Prairie Creek drainage covers about 2,200 acres of virgin redwood lands, with a wide range of conditions from the best pure redwood sites to Douglas fir-redwood sites of poor quality along some of the ridge tops. Some Port Orford white cedar, Sitka spruce, lowland white fir and several hardwoods are also found on the unit. Private cruises show a stand of 209,700 M B.M. of which about 190,000 M B.M. is redwood. All of the proposed experimental forest is within the area now under option for early purchase but only 643 acres have been acquired to date. The area already purchased, however, includes the lower, most accessible part of the drainage so that development of the area can be started at any time. Surveying and some trail and headquarters development are planned for this summer. A small ERA crew is already at work and an 80-man CCC camp now being established will be used partly for the development of the High Prairie Creek area.

Contract States

Meetings. Haig spent the last 10 days of May in this region. Contact was made with Kuenzel, Liming, Chapman, and Auten at St. Louis, Mo. A tour of the Mark Twain and Clark National Forests provided Haig with a general cross-section of the region, its research problems, people, and the status of the forest resource. The group was joined at

Rolla, Mo., by Dr. Hall and Dr. H. A. Buehler of the Missouri School of Mines, proceeding to the Sylamore Branch Station in the Eastern Division of the Ozark National Forest where Supervisor Phil Bryan and Louis Gosenbaugh joined the group for a two-day conference of Ozark forest problems. The Sylamore Experimental Forest was traversed and its future given consideration by the group. The return of the group by car to Columbus gave Haig additional contact with the forest problem in Illinois, Indiana, and Ohio.

Cooperation: Ohio Woodland Survey. The Station was represented at a meeting of the Ohio Woodland Survey on April 20. Speakers included Dr. L. D. Bauer, Department of Agronomy, Ohio State University, who spoke on forest influence in relation to soils; Professor D. T. Mathews, School of Forestry, Ann Arbor, Mich., who spoke about some considerations of cost in cutting in the farm woods; and Mr. J. S. Houser of Ohio Agricultural Experiment Station, who spoke on forest insect problems.

The Station is cooperating with county field crews taking stem measurements on standing trees in Holmes and Franklin Counties, Ohio. These measurements will provide the basis for additional volume tables for the use of the Survey.

County Agricultural Planning Committee. Several meetings were held at the Station in which representatives of the Extension Service, Bureau of Agricultural Economics, and Forest Service and Soil Conservation Service crystallized plans for preparing a bulletin on "Woods Management" for use of township committeemen and farmers in the ACP program, and County Planning Committees in this region. By general agreement, the bulletin will be non-technical and understandable to the layman.

A rough draft of the textual material was prepared by Hall. Suggested alterations and revisions have been incorporated and copies are now in the hands of the members for their detailed attention. It is planned to issue this bulletin through the Extension Service, with illustrations drawn from files of the cooperating bureaus.

Cooperative Farm Forestry Research: Ohio. The formal release of \$2,000 from Norris-Doxey funds on April 3 set up a cooperative research project with the Ohio Woodland Survey. The latter is financed with WPA funds which are subject to many restrictions preventing the full and smooth coordination of a survey and release of its reports. This farm forestry project will fill the gaps in making the findings of the survey available at an early date. A portion of the fund is being used similarly in bringing out the findings of the survey of older plantations.

Indiana. A project designed to explore the problems of growth in farmwoods has been proposed between Purdue University Agricultural Experiment Station and the Central States Forest Experiment Station. It is proposed to extract as much information as possible from plots established 10 years ago, and to go on from there and determine the growth of the several forest types. The problem of growth is recognized in the accepted Indiana Farm Forestry Plan as the most pressing of all.

Personnel. Charles M. Genaux, Associate Professor, School of Forestry, Iowa State College, and Iowa Agricultural Experiment Station, was appointed collaborator of this Station, effective April 16, 1940.

### Intermountain

Students Visit Intermountain Research Projects. During the months of April and May more than 100 students in range management, botany, animal husbandry, and agronomy have visited one or several of the range research projects in the Intermountain region. Range students from the University of Missoula, Montana, visited by means of bus the grazing experiments at the U. S. Sheep Station, Dubois, Idaho; reseeding work in the general vicinity of Ogden, Utah; and the Desert Branch Station in Utah. Range and animal husbandry students of the Montana Agricultural College from Bozeman visited the grazing work at the U. S. Sheep Station, Dubois, Idaho. Range and animal husbandry students from the Utah State Agricultural College also visited the work at Dubois and several of the reseeding projects in northern Utah. Botany and agronomy students of the Brigham Young University visited the reseeding and re-vegetation projects in northern and central Utah in a caravan as part of their trip through northern Utah. A total of 97 students have visited the projects at Dubois. This happens to be the greatest number so far during the present year, but the numbers are only somewhat smaller on some of the other projects that are available for examination during this school year.

### Lake States

Personnel. Through arrangement with Region 9 several men from national forests have been detailed to the Station during the spring months to assist in organizing Cooperative Farm Forestry projects. Kenneth Pomeroy (Manistee) has headed up the field work on the pasture-woodland experiments in Wisconsin. Darold Newville (Chippewa) and Harold Peterson (Regional office) have assisted on new projects in Minnesota and Michigan. Gordon Fox (Huron) has been assigned to a short-term study of the place of small timber sales in national forest management in the Lake States region. Gerald Kruse (Superior) is helping to complete a timber depletion study for the Forest Survey in Minnesota.

These detailers have enabled the Station to handle an exceptionally heavy spring work load resulting from allotment of new funds late in the year and from educational furloughs in the regular staff. All of the men will resume their regular duties on the national forests on July 1.

Photographs. A group of pictures submitted by Paul Zehngraff comprising four different series illustrating the proper management of red pine, jack pine, mixed red and jack pine, and aspen, have been considered outstanding by R. S. Monahan of the Division of Information and Education. "From the standpoint of continuity, adequate descriptive information, composition and definition, these photographs are easily superior to any negatives submitted by any Research personnel for many months."

Meetings. The Station was represented on the program of the Minnesota Academy of Science held in Minneapolis on April 20, 1940, by two members of its staff. Roe presented a paper entitled the "Longevity of Red Pine Seed," and the title of a paper presented by Rudolf was "When Are Pine Cones Ripe?"

#### Northern Rocky Mountain

Piquett Creek Experimental Forest. This area in the ponderosa pine type on the Bitterroot National Forest, is the Station's newest acquisition. Through the cooperation of the regional Division of Engineering and the Bitterroot Forest, a base line control made with transit is being run around the area.

"Show-me" material completed for the Deception Creek. The swelling stream of visitors to our experimental forests has increasingly emphasized the need for written material describing the studies underway at these research centers. Two years ago we partially met this need for the Deception Creek Forest by issuing a small booklet, "A Guide to the Deception Creek Experimental Forest", which gave the location, description, purposes, and research projects of the forest. But more detailed descriptions of the various study areas have been continually in demand.

Just issued is a supplement to the "Guide." Entitled "What to See and Where to Find It on the Deception Creek Experimental Forest", this supplement is lettersize and contains a map which shows all the study areas and main features of the forest, and, following this, 20 pages each devoted to an individual study area.

The material is so arranged that the visitor with the "Show-me" pamphlet in hand may find his way about without guidance and study each area in as much detail as he wishes. Additional

material on plot installations and results is posted in bulletin board signs located on many of the study areas. It is believed that the present material should satisfy quite well our present show-me needs for this forest. Similar material for the Priest River Forest is in the process of preparation.

Montana Forest School students visit Priest River. Led by Dean T. C. Spaulding and Professor C. W. Bloom of the forestry faculty, 31 University of Montana forestry students visited the Priest River Experimental Forest from April 27 to 29 as a part of a tour of Montana, Idaho, Washington, Oregon, and California made annually by seniors attending this forestry school.

Word pictures of the needs for forest research, how forest research is organized within the Forest Service to meet these needs, and how research is contributing to the better management of forest lands, were sketched for the students by H. T. Gisborne. He also explained fire research results at the Priest River Station. It was pointed out that fire danger measurements made to rate the class of each day throughout the fire season, and now practiced throughout the United States, were originated at the Priest River Station. The students were then shown how these measurements are used to get better fire control at less cost.

A description of the forests of the Northern Rockies and the problems involved in growing timber crops, especially in the western white pine type, was given by C. A. Wellner. Studies in methods of cuttings, intermediate cuttings, and regeneration in progress on the experimental forest were visited and explained to the students.

Personnel. Kenneth P. Davis, head of the Division of Silvicultural Research at the Northern Rocky Mountain Station for the past 3 years, left Missoula the latter part of April for Washington, D. C., to take over his new duties as assistant to Dr. Haig.

#### Pacific Northwest

Visitors. Four groups of forest school students visited the Wind River Experimental Forest in May, numbering from 15 to 46, and were shown about for a day and a half by either Munger or Isaac. Some of these groups also visited the Pringle Falls and Cascade Head Forests. Several other groups and individuals also visited our field stations for "show-me" trips, notably a party of about 70 under the auspices of the Forest Practice Committee of the Western Pine Association and the Society of American Foresters visited Pringle Falls where they were shown our demonstrations of methods of cutting, tree evaluation, and stand improvement.

## FOREST ECONOMICS

### ECONOMIC-SOCIAL BENEFITS

#### Allegheny

Anthracite Survey. R. D. Garver and R. W. Nelson, of the Division of Economics, spent 3 days with Director Shirley and the local economics staff in a visit to the anthracite coal region. Major objectives and immediate plans were discussed at length and later received Division approval. A condensed statement covering them has been mimeographed now for general distribution to cooperators, influential people in the region, and others whom we may wish to interest in the Survey.

Forbes prepared a text to accompany maps showing, as graphically as possible, the seriousness of the fire problem in the hard-coal region as a whole, the extent of the present State effort in fire protection, and the possible use of emergency labor in constructing desirable physical improvements. The text covers the 32 projects for protecting the Wyoming Valley against fire, compiled by Ritter in his report to the Pennsylvania Department of Forests and Waters. We hope that this publication will arouse local public opinion to the seriousness of the forest fires and will encourage Luzerne County or its townships to sponsor, from WPA or other emergency funds, the construction of necessary improvements. On the basis of Ritter's recommendations, we have already joined the State in endorsing, as part of a district-wide system, certain of these improvements on private land. The Wyoming Valley Chamber of Commerce has decided to set up on a trial basis a forestry division, with a paid executive, which we believe will go far toward translating into action those and future recommendations of the Survey.

The appointment of Dr. Edward W. Carter of the University of Pennsylvania as a part-time collaborator has greatly accelerated the pace of our consideration of tax delinquent lands immediately available for designation under a 1933 statute as County Forests. Noonan's investigation from courthouse records and field work of 40 tracts tax delinquent since 1912 and apparently in Luzerne County ownership, has reduced the number to 13, aggregating about 2,500 acres. This would be a wholly insignificant acreage (it bears no relation to the acreage which has become delinquent during the depression years) did it not offer an immediate opportunity to sound out local sentiment toward community forests, and to work out methods of administering them at trifling, if any, cost to depleted public treasuries. Preliminary contacts with key officials and citizens have been encouraging. Dr. Carter has found

that some of the other counties apparently have their records of county ownership in excellent shape and that there may be wide differences in extent of delinquency.

The forest inventory has got underway with a bang. Preliminary discussion with Garver, and a three weeks visit from Girard, have led us to hope that both field and office work can be accomplished with WPA help with the same high standards of accuracy as the Forest Survey and with greater intensiveness. Luzerne County will be covered by lines 3 miles apart and 1/5-acre sample plots every 8 chains. Full use will be made of aerial photographs in this and other connections. Local volume tables for 3 site classes (a fourth is non-commercial) have been prepared by Girard, with the help of Mesavage. Detailed field instructions for the inventory have been drawn up which, by eliminating every item which is unessential to the main purpose, should make it possible to get the essentials "cold". The caliber of men so far assigned to our WPA project makes us confident of success.

#### Appalachian

Inventory. The field crews in eastern Virginia made good progress during April and May, despite the fact that only 3 men had had previous experience with the Survey. By the first of June practically all of the lines in the  $6\frac{1}{2}$  million acre coastal unit were completed and several crews had already started work in the first of the two Piedmont units. Two additional crews were added during the past 2 months, bringing the total to seven 3-man crews.

Girard spent nearly 3 weeks in eastern Virginia during April checking field crews and taking tree measurements for volume tables. Volume data and log grades were recorded for approximately 3,000 sample trees.

#### Northern Rocky Mountain

General. On April 23 Winters talked at the annual banquet of the Lions Club at Orofino, Idaho, on the present and future forest industrial situation in Clearwater County, Idaho.

Winters, Kemp and Hutchison discussed survey inventory and growth data for Lincoln County, Montana, with Forest Supervisor Klehm and staff of the Kootenai National Forest. Mr. Klehm made a number of suggestions that will be very helpful in making the survey report deal more adequately with local conditions. He hopes to use the survey report as a background of general information on Lincoln County to give service clubs and other groups of local citizens.

Inventory. During the month of May survey type maps and volume data for Flathead and Lake Counties were adjusted to account for cutting and fire losses which had taken place between date of mapping and January 1, 1940.

Beginning May 6 eight men went to the field to map and estimate the timber volumes in Missoula County.

Growth. The report "Forest Increment in North Idaho" by L. J. Cummings and Paul D. Kemp, which has been released, shows that the current annual increment for that portion of the Inland Empire amounts to 636 million board foot of which 165 million board feet is western white pine, the keystone of North Idaho's lumber industry. Cutting drain of all species averaged 622 million board feet annually during the period 1935-38; cutting drain of white pine for the same period averaged 351 million board foot annually. The average annual kill by fire for the period 1931-37 averaged 91 million board foot of all species combined, 15 million feet of white pine. Without allowances for an indeterminable amount of fire-killed timber that was salvaged, the total current drain amounts to 712 million board feet.

While current annual drain of white pine timber resources exceeds growth by some 200 million board feet, it should be emphasized (1) that North Idaho has approximately a million acres of decadent sawtimber stands in which growth is assumed to balance mortality and decay and (2) that the annual productive capacity of the area occupied by such decadent stands is about 275 million feet.

Potential annual growth figured on the basis of 75 percent of normal increment is estimated to be 1.6 billion board feet or approximately  $2\frac{1}{2}$  times current annual increment. It is estimated that approximately 50 percent of the difference between current and potential increment results from under-stocking and abnormal age class distribution of growing stands, approximately 30 percent is accounted for by the area now occupied by non-growing stands, the remainder is the practicable mean annual growth on lands that are now deforested.

#### Pacific Northwest

Inventory Revision Progress. Field work commenced this year in Kitsap County, Washington, and will be completed about June 7. Next in order are Mason and eastern Jefferson Counties, which will complete the Olympic Peninsula and lower Puget Sound Counties. When field data for those counties are compiled, new figures for the Olympic National Forest and Olympic National Park

will be available.

The Cowlitz County report has been distributed and the report for Washington County is awaiting multilithing. Revised 1-inch-to-the-mile type maps have been published for Washington and Lewis Counties. Demand for the county maps and the lithographed State maps continues strong, and demand for revision of the lithographed maps is commencing.

Reinventory Results. Washington County, Oregon, is an example of the extent that fire may alter the industrial history of a forested county. In 1932, prior to the famous Tillamook fire, this county had nearly 5 billion board feet of standing timber, more than 80 percent of which was Douglas fir. At the very back door of Portland, this county had promise of an active industrial life. The McKay Creek fire in 1932 and the Tillamook fire of 1933, which started in Washington County, killed about one-third of the County's timber. Salvage operations and liquidation of unburned timber gathered momentum and speeded up depletion of the County's timber. Subsequent fires in 1938 and 1939 killed more timber and the new forest survey inventory showed that as of March 1, 1940, the County had but 2.2 billion board feet of standing timber of which only 1.2 billion board feet was old-growth Douglas fir.

### Southern

During April and May Eldredge attended six out of town conferences and meetings. On April 4 he took part in a meeting of the Executive Committee of the Southern Pulpwood Conservation Association at Savannah, Ga. May 6-8 he took part in the Joint Congressional Committee conference at Holly Springs, Miss. May 16 he delivered an address entitled, "The South's Forest Resources: Their Development and Use" at a meeting of the Georgia Forestry Association in Atlanta.

Ineson and Hawes were in the field half time collecting data on the financial structure of wood-using industries study.

Mensurational. Wheeler developed a 1/4 acre basal area number of trees stocking reference based on E. Foster's work in 1932 and a comparison with later data, including empirical information from the Forest Survey. The loblolly pine type, uncut second-growth plots in Georgia Unit #3, were coded from these data. Preliminary analysis showed an average stocking, on this base, of 34 percent. Forty four percent of the plots were below 25 percent stocking.

Preparation of special data for inquiries and correspondence required considerable time. Examples are: discussions of stand table and volume per acre data for fire damage appraisal with Bickford, filling numerous requests for Survey volume tables, growth and drain data for the Yazoo Backwater study, red cedar volumes by States for Region 7,

East Mississippi pole data for the American Creosote Works, an estimate of the pine inventory and growth in the Pearl River Valley of Mississippi, a check of Southern States data for the Manufacturers Record, and estimates of cottonwood and other soft-textured hardwoods growth in the Mississippi River Delta for the U. S. Gypsum Company. Cooperation was continued with the Appalachian Station in checking their field sheets for Virginia Unit #1 preparatory to card punching. New card forms were designed.

Growth. Carried on preliminary work for 1938 growth estimates for 20 Survey units. Prepared a summary and analysis of pine diameter growth data for trees of pulpwood size. Stover prepared comments on the National Resources Board manuscript "The Southern Forests," and an article, "In Twice the Life of a Pine," for the University of Florida Forest School annual.

Drain. Smith and his assistants were engaged during much of the period in a cooperative project in which census forest industry questionnaires (Form 311) for Mississippi, Georgia, and Florida were routed through this office for editing. Nine hundred reports were handled during this period.

The lumber production for 1938 was allocated to units, 1938 drain calculations for the State of Mississippi were completed, and 1938 pulpwood drain was compiled for all units. Other work included compilation of drain and production data for a number of special projects: the Yazoo Backwater study, pulpwood drain for Georgia, Louisiana, and Mississippi, cottonwood consumption in the Mississippi Delta, pine drain in the Pearl River Valley area, and supervision of the compilation of county lumber production for 1936 and 1937 for the Alabama Bureau of Business Research.

#### FOREST TAXATION AND INSURANCE

##### Pacific Northwest

Taxation. In April, field work was continued in Stevens County, Washington, in connection with the study of the adaptation of local government to land use. It is interesting to observe that there is no sentiment against Federal acquisition of land in this county and no interest in the subject of Federal contributions in lieu of taxes on the part of the numerous public officials contacted. The loss in tax base due to the Federal acquisition program over the past four years probably has been proportionally greater in this county than in any other county in the region.

Readjustments due to Federal acquisition have considerably reduced the number of farms. There probably has been no net decrease in county population, but there has been a considerable concentration of the population in the county seat and the other towns. After receiving cash for their farms, the people have moved to town, a move they have always wanted to make but which had been impossible without cash.

Property tax rates for 1940 that are in effect in all districts of all counties of Oregon and Washington were obtained from county officials. An analysis of these data reveals that over-all tax rates levied by governmental units as large as a county, i.e., applicable to all rural taxable property in a county, are nearly at the same level in both States and are comparatively uniform as between counties. Special tax rates of districts smaller than a county, generally school districts, are usually of a greater magnitude. The range of tax rates among the districts within any county is usually greater than the range of over-all tax rates among the counties of the two States. Total tax rates applicable to rural property have an extreme range from 10 mills per dollar in several districts of Jefferson County, Oregon, to 105 mills in part of Malheur County, Oregon. A study of these tax rates further reveals that the statutory tax rate limitation in Washington is not very effective. The range in total tax rates within counties is generally less in Washington than in Oregon; probably due to the greater amount of school equalization funds available from sales tax in the former State.

#### Southern

A progress report from Craig's tax index project, presenting data on ad valorem taxes on forest property in five selected counties in Mississippi for 1936-1939, was issued in April as Occasional Paper No. 89.

Field work was completed in two additional Mississippi counties, George and Webster, the results were compiled, and a new State average based on seven counties (Alcorn, George, Holmes, Marion, Newton, Quitman, and Webster) was computed. These data will be issued early in June in a supplement to Occasional Paper No. 89.

Field work in Alabama will be started in June, after an appraisal of tax records and methods of assessment in that State. Property taxes in Alabama are levied in February on assessments made during the preceding October-December period, and are payable on October 1 following. Hence data will be taken by Craig on taxes levied and payable in 1940. Escambia County will be probably the first county studied. Final decision on the other counties to be studied will be made after a conference with State officials.

## NEW PUBLIC DOMAIN

### Pacific Northwest

Checking of numerical data in the typewritten chapters of the New Public Domain report began April 16 and ended May 20. This work covered practically all of the numerical data to be included in the entire report. The remaining work consists mainly of putting together analyses of tax collection laws and practices, effects, and remedial measures. The problem of what to cut is difficult to solve because of the physical, economic, and social complexities of the Douglas fir region. The danger of cutting is that the report will be unbalanced, leading some of the readers to accept the solutions offered as the entire answer to the problems and others to discount the whole because of the omissions. The danger of not cutting is that the report will be too voluminous.

The longer one deals with this subject the more one becomes convinced that many of our fundamental errors in land use and ownership lie in the almost universal tendency to treat parts of a whole as independents, resulting in over appraisals--resulting in a total sum that is greater than the whole. This tendency applies as much to extension into the future of a property that is simple in terms of today as to one made up of several similar parcels or one made up of several dissimilar parcels. It appears, also, to apply as much to physical and biotic as to economic and social appraisals. The difficulty may arise from a habit of lifting unrelated and unrelated cores of knowledge out of the unknown.

This bi-monthly period has reemphasized the need of realistic measuring sticks in addition to the dollar in applying the acid test "will it pay in the long run" to alternative uses and ownership of deforested land. In attempting to compare the economic advantages of one use with another it is quite the custom to rest the case entirely upon which of the uses will yield the greatest profit in dollars. It becomes more and more apparent that the result of this test unmodified by other tests will result in an over appraisal in one direction or another. It would appear that potential man-days of useful occupation and possible and probable planes of living were at least as dependable measuring sticks as dollars. It would also appear that we can approach nearer to the truth when we interrelate all three--work opportunities, planes of living, and dollars. Such an interrelation automatically brings out of hiding that point of view which foresters have by the very nature of their occupation been forced to take--the long-range one.

The complex problem of bringing our wild Douglas fir forests under control, of converting them from unregulated to regulated forests, of stabilizing ownership by shifting from broadly interrupted income flows to regular flows, was illustrated by a field examination of about 160 acres in the upper Willamette River, made in April in conjunction with the Columbia River Section of the Society of American Foresters. On this small acreage not one but three or more different economic-silvicultural attacks appeared desirable. On one part clear cutting small areas to bring about re-establishment of Douglas fir was in order; on another part, selection of individual old Douglas firs without disturbing a well established understory of western hemlock appeared best; on the third, selection of a few sound, old Douglas firs and leaving the poor quality remainder to occupy the space, however unwise that looked from a silvicultural point of view, seemed the only way out for any private owner who chose to avoid bankruptcy or forfeiture of his property.

Among tasks performed were: (1) preparation of a statement of the settler problem in the forest districts of Oregon, possible remedial measures, and administrative problems in rural zoning for use of the Forestry and Lumber Committee, Portland Chamber of Commerce, and the Governor of Oregon's Economic Council; (2) preparation of a preliminary list of points in support of county as opposed to State forests and in support of State as opposed to county forests for comparison with State and Private Forestry, Regional Office, R-6; an enlargement of a land-use classification map of Snohomish County based on topography, soils, cover, habitations, roads, and schools, for comparison with the broad land-use district map of that county prepared by Forest Management for studies of adequate fire control.

#### PRIVATE FORESTRY

##### Central States

Farm Woodlands. The analysis of the Illinois farm woodland data was continued during this period. Practically all of the work tables for the woodland inventory phase were completed. Tests of the variation of the volume per acre within and between counties as well as area occupied were the criteria employed in determining the site-type, condition and county combinations to be recognized. The stand structure tables, one for each of these combinations, are now being prepared.

Lake States

Farm Forestry. Cooperative farm forestry projects were inaugurated in Minnesota and Wisconsin during April. The Wisconsin project, involving a study of comparative returns from use of hill lands for pasture and woodlands, is centered in Richland County, in the unglaciated section of the State. Six cooperating farms were selected, on each of which a series of three 5-acre experimental pasture plots was laid out. One plot in each series was renovated by disking, liming, fertilizing, and seeding to legumes; a second consists of untreated open pasture; the third of grazed woodland. Forage yields are to be measured by the use of both livestock and clipped quadrats. Concurrently, a timber yield study for comparable sites is being made. Responsibility for the project is divided between the Wisconsin Agricultural Experiment Station and the Lake States Forest Experiment Station.

In the Minnesota project, emphasis is on problems of timber utilization and marketing, with particular attention being given to markets on the farm. An intensive survey of present wood use on the farm is being made in two counties in the southeastern part of the State. At the same time, the Agricultural Engineering section of the Minnesota Agricultural Experiment Station is attempting to develop designs for minor farm buildings which will be adapted to greater use of local hardwoods. One or more experimental structures will be built during the near future.

Southern

Farm Woodland Study: Bond spent a considerable part of May in planning and supervising the field work of a farm woodland study in Hempstead County, Arkansas. The study is being made as a part of the Bureau of Agricultural Economics-State Agricultural Station farm management project. Its purpose is to provide a better appraisal of the present and potential contribution of farm woodlands to farm economy.

Agricultural Aid Arthur W. Nelson, Jr. is cruising woodlands on 80 farms and obtaining records of growing stock, growth, yields, costs and incomes. The field records are being analyzed and correlated and growth and income possibilities for the woodland occurring on the usual farm of the county are being computed.

In Hempstead County there is keen competition for stumpsage by the lumber industry, pulp and paper industry, veneer plants, treating plants for posts, poles and ties, and handle plants. The farmer is offered aid in managing his woodlands, not only by the

Soil Conservation Service, State Forest Service, State Extension Service; but also by a large lumber company. This company encourages selective cutting by furnishing its forester to mark the timber for cutting, by paying the farmer for producing sawlogs from good trees and pulpwood from tops and cull trees, and by paying fair prices for stumpage [~~\$4 to \$6 per M and \$.75 per unit (4' x 5' x 8')~~].

The farmers have overcut their woodlands in the past, so that saw timber is rather limited and many stands contain only cull species and defective and limby trees. The possibilities of woodlands supplementing incomes from farm crops are now being recognized by farmers and better management is being adopted gradually.

#### FOREST MANAGEMENT RESEARCH

##### FOREST FIRE PROTECTION

##### Allegheny

Control. Little has completed the first draft of the Station's portion of a proposed bulletin entitled, "Forest Fires in New Jersey", which is being written jointly with the New Jersey State Forest Fire Service. This publication will summarize the results of several years' work on the analysis of New Jersey forest fires.

A working plan for an administrative study in the use of disked, shaded firebreaks for possible replacement of the present annually burned, shaded firebreaks now in use on the State Forests in South Jersey, has been prepared in cooperation with the Forest Supervisor of the Lebanon State Forest.

Behavior. Current fire weather readings were obtained on the Lebanon throughout the spring fire season to be used in checking the Region 7 fire danger meter and the Station's adjusted meter. The State Fire Service made good use of these readings during the fire season.

##### Appalachian

Fire Damage Appraisal. The new method for evaluating mortality and cull losses caused by fire, mentioned in previous reports, will be completed next month. Preliminary tabulations which follow indicate that the average fire causes from \$1 to \$2 damage per acre from these

## FOREST FIRE PROTECTION (Cont'd)

two sources alone.

Forest type	Forest condition class	
	Sawlog	Undersawlog
Hardwoods	\$ 1.20	\$ 1.65
Pine-hardwoods	1.30	1.50
Pine	1.90	1.00

There is one other important tangible effect to be included; namely, effect of fire on rate of growth. Work is progressing on this phase also but findings to date are contradictory. At least, the growth of some species is apparently unaffected by fire, while others show serious damage. For example, an analysis of Forest Survey records indicates that the growth of white oak bears no relation to degree of fire damage, while yellow poplar suffers severe loss in increment. For stands in which no fire has occurred, yellow poplar averages 3 inches diameter growth in 10 years. For stands with medium fire damage, the growth has been only 1 inch for the same period. Such a differential, translated into volume, will be highly significant for this species now brings about \$9 per M stumpsage.

When these damage appraisal tables are completed, the States, private organizations, and Federal fire protection agencies will have, for the first time, a method of appraising damage on a sound basis.

For all major forest types in the Appalachians where young growth or second growth prevails, damage is primarily confined to unmerchantable trees. But the new technique evaluates the delay to future returns caused by fire and thus results in a sound appraisal.

What the above method does not evaluate that is extremely important, is the damage to watersheds, fish and game, recreation, and other intangibles. Determination of such losses now is to be a high priority job when present work is finished.

#### California

In collaboration with the Regional Forester's office a study is being made to provide a statistically substantiated basis for planning fire protection on the national forests of

southern California. The finished report will be broader in scope than any of the earlier bulletins dealing with the fire problem in northern California. It will include discussion of the development of the need for fire protection, the history of fire control, and present problems and indicated solutions, particularly the speed and strength of attack required in different vegetation zones. The first draft of the report has been completed.

A study has been initiated to ascertain the possibility of improving water for fire-suppression purposes by the addition of wetting agents. Most forms of vegetation have a waxy, resinous, or glazed surface which is not readily wetted by water. During the dry fire season in California, forest fuels almost invariably are coated with a fine layer of dust which further renders the surfaces difficult to wet. It is reasonable to suppose that water, which would quickly penetrate the dust and spread evenly over the waxy surface of the fuel, would have its value for fire suppression appreciably increased.

Surface-tension and contact-angle measurements have been made already with solutions of many available commercial wetting agents. It has been found that as little as 0.1 percent solutions of the better agents will make water sprayed upon pine needles spread evenly in a thin film over all surfaces instead of sticking in the usual form of isolated droplets. As little as 0.15 percent will cause the film of sprayed water to sink into the body of the pine needle within 40 to 60 seconds.

A simple laboratory technic has been developed for studying the influence of chemicals on fire and will be utilized in a preliminary way to investigate solutions of monoammonium phosphate and other water-soluble chemicals with and without spreading and wetting agents.

Two uses of water which may require different distributions of liquid over the fuel surfaces to yield optimum results in fire suppression are under consideration. One is concerned with water as a vehicle for application of chemicals to unburned fuels as a fireproofing measure. The other deals with water with and without fire-retardant chemicals applied to burning fuel as an extinguishing agent.

#### Northern Rocky Mountain

A 4-day fire danger conference at the Priest River headquarters, April 23 to 26, was attended by representatives of the regional office, the 10 western forests in Region 1, Glacier and Yellowstone Parks, the Omaha office of the Park Service, the Pacific Northwest Experiment Station, Region 4, and the Weather Bureau. The first two days were devoted to the technics of danger measurement while the last two were given to a discussion of the uses of these measurements.

At the first conference of this kind, held in 1935, the announcement of one or two specific uses of danger ratings was quite an event, such ratings having been previously more or less experimental and even theoretical. The meeting this year was quite different, with field men no longer complacently tolerating the super-refined research measurements. This year the demand was repeatedly and persistently for more refinement, more accuracy of measurement, and hence more dependable use.

Fuel moistures represented by only half-inch sticks exposed under one-fourth shade on a flat are no longer sufficient. The moisture content of this kind and size of fuel is now wanted under full shade, on north and south slopes, and at all elevations. The moisture in larger-sized dead wood, up to large logs, also is now appreciated as significant information that can be actually applied in fire control organization and dispatching. Separate danger meters are foreseen rating (1) forests or seasons, (2) man-power placement, (3) dispatching practices, and (4) suppression strategy and tactics. Spot accuracy rather than average status of fire danger is now recognized as definitely usable information. Fire research in this region is no longer out in front offering new practices; it is sadly behind the demand for new technics.

As is common to many sciences, progress is definitely dependent upon instruments and instrumental technics. Four seasons of research in the moisture at different depths in large logs at Priest River have shown that this factor does vary significantly, but the blinkometer method of measuring it is too expensive and possibly too technical for general field use. Four seasons of research in vegetation condition have likewise shown that with moisture content, the big variable in this fuel, lack of instrumental methods of measurement is the big obstacle. Our condition is similar to that of the physiological plant ecologists for whom Livingston stated in 1935 that "just what to measure must depend to a considerable extent and for a long time to come on what we are able to measure." Obviously, if our field men want numerical indices of fire danger we must "be able to devise instruments and technics by means of which numerical indices of environmental capacity may be secured," as Livingston stated 5 years ago for his science.

Three years ago we conducted a "durability test of low-cost wind gages" under two exposures at Priest River, operating in each case a Stewart, Fricz, and a Chisholm low-cost anemometer side by side and checked by a recording Weather Bureau standard anemometer. The objective was to obtain specific records of the durability of these low-cost instruments so that this feature

could be covered when calling for bids.

A recent advertisement by M. C. Stewart apparently procludes the necessity of continuing this test after this year. Stewart now advertises that his standard instrument retailing at \$15 is "Guaranteed to operate 500,000 wind miles. No oiling required," and that it will "withstand a maximum velocity of 90 m.p.h." As the average fire danger station total velocity in this region does not exceed 14,000 miles for 6 months of exposure, and seldom, if ever, experiences a 90-mile wind, this guarantee insures an instrument life of around 35 years for summer stations and 17 or 18 years for year-round operation.

This is a cost of less than 50 cents per summer station per year which is lower than the instrument cost for measuring some other factors of fire danger and is believed, therefore, to be consistent and reasonable. Our durability test can be discontinued as it is altogether probable that within 35 years still further improvements will be made in anemometer design which will in themselves vitiate the results of our test.

#### Pacific Northwest

Effect of Shape, Density, and Method of Exposure of Fuel Moisture Indicator Sticks. During the summer of 1939 a study was made of square, round, and flat fuel moisture indicator sticks of the same cross section prepared and exposed in different ways in order to answer some of the questions that arise about the effect of preparing or exposing the sticks in various ways. The sticks for this experiment were prepared from one lot of ponderosa pine sapwood of varying density; half of them were cut to a length of 22 inches and the other half were cut to contain 100 grams of oven-dry wood. Then the entire lot of sticks was divided again into halves containing equal representation of each shape, density, and method of preparation, and one lot was exposed in the open and the other exposed under a screen. A report of these tests has been mimeographed for distribution.

The following conclusions are based on inspection of the data and the use to which the sticks are put in practical application:

1. There does not appear to be any important difference between round and square sticks of the same cross section.
2. There does appear to be a small but important difference between sticks made from high density wood and sticks made from low density wood. Therefore, the practice of discarding sticks of high or low density wood is sound and should be continued.

3. Flat sticks of the same cross section as the round and square sticks show an important difference in behavior and could not be used interchangeably with round or square sticks.
4. In general, screening does not appear to make a very great difference in the daily minimum moisture content of the sticks. The effect does not amount to as much as one percent in the afternoon averages.
5. There is not any important difference between sticks cut to weight and sticks cut to length, provided that the densest and lightest wood is eliminated under both methods of preparation.

Conferences on Adequate Fire Control Study. Two groups of private, State, and Federal foresters have met at the Station to go over the analysis phase of the study of adequate fire control on the private lands of the Douglas fir region. The analysis of fire control in Snohomish County, Washington, as completed by Matthews and Morris, was the principal item presented and discussed. Each group found the material presented to be timely and interesting, and there was considerable discussion. It is planned to complete and publish the analysis of present protection and a plan for adequate protection of this sample unit as soon as possible and then make a similar analysis and plan for a unit in Oregon.

#### FOREST GENETICS

##### California

Hybrid Analysis. Many of the hybrid pines at the Institute of Forest Genetics are now producing pollen in usable quantities, although the number of cones produced is still too small for consideration. Further testing of these trees is desirable and it is planned to use the pollen for this purpose. It is necessary, therefore, to detect those trees among the hybrids that may be self-pollinators or possibly apomicts of some kind, and this must be done without recourse to cone characters in most cases. Catkin characters are valuable in some instances when these are present, but as early determination of these trees is necessary, vegetative characters must furnish the bulk of the evidence in this work. The constancy of any particular character may vary considerably

within a species or between species, but each species has certain character combinations that remain constant. Little work has been done in this field because cones are often considered requisite to pine identification, and furthermore, many related pines show little or no difference in vegetative characters under an ordinary hand lens. When material is brought into the laboratory and magnified 50 times, however, minor differences are exaggerated sufficiently to stand out sharply. Some of these have proved to be fairly constant within a single species and are well adapted for use in determining the purity of species and the heterozygous nature of hybrids. Among the most useful needle characters discovered to date are the size, shape and number of marginal serrations; the size, shape and number of stomata; and the presence or absence of longitudinal bands, together with the character of the wax in these bands and in the orifice of the stomata, in some cases the wax being powdery, in others glossy, in some cases translucent and in others opaque. Publication of the method is contemplated when sufficient data are accumulated to check its general reliability.

Physiology. Grafting experiments with pines have been continued and several now graftings were made. As was expected, on theoretical grounds, intra-generic grafting among conifers can also be successful. Abies venusta seedlings grafted on Pinus ponderosa stock last fall passed the winter rest period safely and with the advent of spring resumed their growth.

Physiological studies of ponderosa pine seedlings have been continued. It is interesting to note the effect of high temperature on the viability of the seedlings. After 80 days of continuous heating of dry seeds at 130° F some of them still germinated. Certain morphological abnormalities in the development of the treated seedlings were recorded, but no cytological examination of the abnormal specimens has been made as yet.

## MENSURATION

Appalachian

Erratum. In the Bi-monthly Report for April 1, the coefficient of D on the next to the top line of page 27 should be

$$(.0124375tL^2 - .04975tL - .1605L).$$

The coefficient as shown is the one that will result when  $t = .5$  has been substituted in the formula.

California

Redwood Region. The redwood volume tables have been completed and are now being prepared for photographing. Work on the taper tables should be completed by fall.

The study of redwood growth acceleration following release, which has been used as a fill-in job for WPA and NYA employees, is beginning to show some results. All of the 500 cores collected last summer have been measured to determine the average ring width before and after release, and the increase in ring width in percent has been calculated for each plot group. The average increase in ring width by groups varies from 218 percent to 746 percent, with an average for all groups of 412 percent. The diameters at the time of release are now being calculated so that the average annual increase in basal areas can be determined for the period since release.

Central States

Stand Studies - Black Walnut. Editorial review on the manuscript reporting the yield of plantation black walnut in the Central States was completed at Columbus in April. Much progress was also made on the review and editing of a second report covering other phases of these plantations in the Middle West.

Tree Studies - Converting Factors. The Clark and Mark Twain National Forests in Missouri have requested help in determining approximate converting factors applicable to sales of stave and heading bolts for tight cooperage used in the liquor trade. The former are 39" long, the latter 23". Timber must be straight-grained, clear, and of highest quality to qualify for select "bourbon" staves. The practice is to fell the largest and best white oak to provide the bolts, which are split from sections sawn from the basal portion of the tree. Sapwood is culled because it lacks tyloses. Sale is on the basis of "chord-feet" measured by spanning the chords of heartwood on the bolt ends, excluding defects. The factors needed primarily are the ratios of chord-feet to board foot for both lengths of bolts, and the ratios of chord-feet and board foot to cords of bolts.

Members of the Station contacted several operations on the Clark and Mark Twain forests in April where woods and mill practices were discussed with Collins and Sword from the two forests. Outlines and forms were revised and reworked, and a CCC crew under Scizort began the measurement of stacked cords from both Federal and private cuttings at the stave mills.

During May, the first data from the Clark National Forest arrived in Columbus. Preliminary analysis of the measurements on these first 10 piles of bolts, containing a total of 21.53 "standard" (i.e. 10-foot) cords from private cuttings, showed on the average 53.6 chord feet per "standard" cord, which is decidedly lower than 80, the factor now in use. For "short" (i.e. 8-foot) cords, this factor calculated out 42.9 chord feet. The number of bolts per cord (in these preliminary calculations) for "standard" and "short" cords, respectively, were 66.4 and 53.1. The mean scale per bolt was .784 chord foot with a spread from .700 to .982. The content of all the piles varied from 0.96 to 5.63 "standard" cords. Additional data arrived near the end of the month, and more will be forthcoming from the eastern portion of the Clark National Forest next month.

Seizert has provided current prices being paid for select bourbon "quartered" bolts measuring 1 chord foot or better at 25¢ per chord foot; #1 bourbons of less measure at 22¢ per chord foot; and "oils" at 7¢ per chord foot.

An outline was prepared to cover checking of field data and transfer of computed values, and to serve as a guide for the workers in the Station's WPA computing section in the further analysis of these data when received.

Another outline was prepared to guide the taking of field measurements on the cutting operations, to determine (1) the ratios of chord feet to board feet, and (2) the volume of unused, common top logs left in the woods.

Volume Tables. The first of several local volume tables has been mimeographed and was issued on April 1 as Technical Note 1. This is for yellow poplar in Stark County, Ohio, based on measurements of natural trees provided by the Ohio Woodland Survey. A local table is the type required by the Survey. As additional data accumulate, they will provide a basis for more general tables providing volumes by d.b.h. and merchantable height.

Other local volume tables mimeographed for release as Technical Notes 2 to 4, inclusive, include cucumber, basswood, and red oak. Five others are in the process of being mimeographed.

Experimentation with the Stark County, Ohio, tree measurement data provided by the Ohio Woodland Survey, has produced a satisfactory method of preparing volume tables, by the equation method that provides volumes in board feet for trees of different d.b.h.'s and merchantable heights. A table for yellow poplar and one for cucumber have been prepared for release at an early date.

Statistics. The WPA computing section has been increased from 6 to 11 with the arrival of 5 computers from the Bureau of Business

Rosearch, Ohio State University.

Two covariance analyses were completed on nursery soil fertilizer experiment to test the response of pine seedlings to some of the raw elements and varying amounts of acid phosphate at different pH levels. Data are being analyzed on a triple experimental plan testing N-P-K with and without peat at differential pH as observed by survival early in summer, by survival and height growth in fall, and by length of root and weight of root and top (green and dry weights).

Six Latin squares were completed on an erosion control experiment designed to test the effect of fertilizer, mulch, and species.

Twenty-four factorials (N-P-K type) of fertilizer mix were completed in connection with field planning experiments.

Three covariance and 6 variance of the split-plot type have been completed (observation of stock-season).

Four analyses of variance on pine age and pine cover are being completed at the present time.

Data have been sampled for growth, volume, and yield on the Sylamore Branch Station, and on growth and yield in Indiana designed to obtain the optimum cultural treatment.

Data have been compiled and condensed on the natural thinning study, Ozark Mts., to show the relative composition of stands by species. Eleven Latin squares, on pine seedbed preparation study, with observations on survival, height and catch have been analyzed. Four of these squares are being pooled for further study.

#### Lake States

At the request of Dr. Adolph F. Meyer, Chairman of the Minnesota Water Resources Committee, the Station obtained a series of increment borings on the Bona swamp area on the Chippewa Forest (drained since 1927) to show the rates of growth of trees before and after drainage.

The borings were taken from dominant black spruce and tamarack trees, at distances of 10, 25, 50, and 100 feet from the ditch. The growth after drainage was recorded separately for two 5-year periods, of which one (1927-31) was normal, and the other (1932-36) dry. The results of this study are being presented below:

Table 1. -- Radial Growth of Black Spruce and Tamarack Before and After Drainage in Relation to Distance from Ditch

Distance from ditch (feet)	Black spruce			Tamarack		
	Radial growth for 10 years			Radial growth for 10 years		
	Before drainage	After drainage	Differ- ence	Before drainage	After drainage	Differ- ence
	Inches	Inches	Inches	Inches	Inches	Inches
10	0.54	0.90	0.36	0.46	1.88	1.42
25	0.60	0.84	0.24	0.21	0.99	0.78
50	0.33	0.52	0.19	0.26	0.83	0.57
100	0.26	0.40	0.14	-	-	-

Table 2. -- Radial Growth of Black Spruce and Tamarack After Drainage During the Normal and Dry Periods

Distance from ditch	Normal period		Dry period		Difference	
	Radial growth for 5 years					
	Black spruce	Tama- rack	Black spruce	Tama- rack	Black spruce	Tama- rack
Feet	Inches	Inches	Inches	Inches	Inches	Inches
10	0.44	0.79	0.46	1.09	0.02	0.30
25	0.36	0.28	0.48	0.71	0.12	0.43
50	0.20	0.21	0.32	0.62	0.12	0.41
100	0.18	-	0.22	-	0.04	-

Table 1 shows that drainage did help the growth of trees, at least to a distance of 100 feet from the ditch, the greatest effect being within a distance of about 25 feet from the ditch. Tamarack showed a better response to drainage than did black spruce.

That the drainage is beneficial to tree growth is further corroborated by the data shown in Table 2, which indicate that during the dry period, which is equivalent to additional drainage, the growth was greater than during the preceding period, which was not so dry.

Pacific Northwest

Fuelwood Volume Table for Second-Growth Douglas Fir. In response to a demand from the local farm forestry projects a fuelwood volume table has been prepared for second-growth Douglas fir. Forest fuelwood, sold in cords or some other unit of cubic volume, ordinarily includes both wood and bark. Hence existing tables, which show wood volume only, need to be adjusted to show stem volume including bark for fuelwood estimates. Use was made of the ratio of stem volume including bark to stem volume inside bark. As computed from 165 mechanically selected sample trees, representing the principal diameter and height range, this ratio averaged 118.75 percent  $\pm$  0.370, but it is significantly related to both diameter and height as expressed by the equation:

$$\begin{aligned} \text{Volume of bark and} \\ \text{wood as percentage} \\ \text{of wood volume} &= 115.4759 - 0.1490 \text{ d.b.h., inches} + 0.0486 \\ &\quad \text{total height, feet} \end{aligned}$$

The new volume table was constructed by applying the above equation to values in Table 12 of Technical Bulletin 201, "The Yield of Douglas Fir in the Pacific Northwest." The new table, when checked against the 165 trees upon which the equation was based yielded an aggregate of values 0.16 percent low, and an average deviation of 8.1 percent.

Cooperation. Considerable time has been spent in consultation with foresters of the Soil Conservation Service developing a standard technique for making farm woodland management plans, including timber survey procedure, determination of desirable cutting budgets and methods of making harvest and stand improvement cuttings in farm woods.

In cooperation with the O. and C. Administration a taper table has been prepared for old-growth Douglas fir for use in making cruises by log grade.

## REGENERATION

### Allegheny

The anthracite industry is leaving behind it refuse piles containing as much as five million tons, and valley bottom silt deposits having a maximum depth of 40 feet. The Schuylkill River, which drains the southern third of the region, has been despoiled by siltation to the extent that an expenditure of nearly ten million dollars for justifiable dredging and engineering work has been advised by the Army Engineers to restore its economic values. About 30% of the siltation has been attributed to erosion from mine refuse deposits. The finer deposits dry out and are blown about by the wind during the summer. The destruction of scenic values caused by the barren refuse banks undoubtedly cuts down the anthracite region's share of Pennsylvania's tourist trade, which provides a total revenue of 300 million dollars a year.

In most cases natural vegetation of the refuse banks has been unsatisfactory, even after 75 years. Some banks have seeded in well to gray birch. Pitch or Virginia pines have seeded in at certain localities. Many other species occur sporadically.

A few small-scale but fairly successful bank plantings have been made within the last few years. Because of the physical difficulty of planting, the opportunities for direct seeding on the mine refuse banks should be investigated. It is believed advisable to augment the natural succession by establishing seed-source groups and strips of aspen and birch. Black locust and rose acacia are good prospects for banks containing boiler ashes. Pines can be used to advantage on the rocky and sandy portions of banks.

The washing problem is worst in the fine coal-silt deposits settled out of breaker water. Coal-silt deposits subject to drying out appear to provide a very difficult planting problem.

As a result of a survey of 73 older plantations in northwestern plateau section of Pennsylvania, it has been indicated that (1) the continued planting of red pine on well drained soils at the higher elevations is justified (based on inspection of stands up to 24 years of age); this species is exhibiting none of the symptoms commonly associated with a species existing outside its natural range; there are no indications that widespread failure of red pine is likely to take place in the future, although local infestation or infection may occur as for any other conifer; (2) one-, two-, and in many instances, three-row mixtures have resulted largely in the loss of the alternate species used, and in only a very few instances have they produced the

desired mixed stand conditions. The desirability of more general use of block mixtures seems definitely indicated, especially for such intolerant species as Norway spruce, while on the other hand certain mixtures of white pine show promise of producing merchantable material of good form. European and Japanese larch made excellent growth and had good survival on medium to steep slopes where the frost hazard is negligible and where they were free from undue competition during the establishment period. The future performance of Scotch pine is still rather unpredictable, although many plantations between 20 and 25 years are very thrifty.

### Appalachian

Spruce Type. The seeding and planting of experimental plots for the spruce regeneration experiments were completed this spring. Experimental areas are located on the Monongahela National Forest in West Virginia and on the Pisgah National Forest in North Carolina.

Growth and Site Factors. In the summer of 1938 data were collected on 8 experimental blocks in the Great Appalachian Valley in eastern Tennessee. The analysis of a relatively large number of figures on variations in site factors and growth of young plantations has been practically completed.

Records were kept from the last of May to the first of October on total soil moisture, maximum and minimum surface soil temperature, precipitation, air temperature and humidity by hygro-thermographs, and growth by 10-day intervals. In addition, wilting coefficient of soil and rate of water percolation data were obtained on each block. A few of the statistically significant results are summarized below:

1. Northeast aspects have considerably higher soil moisture contents throughout the season than do southwest aspects. This is true for both total and available moisture. Total soil moisture averaged 5 percent higher for the northeast slopes.

2. A soil moisture gradient of about 1 percent in 80 feet was found on medium to steep slopes. Most of this gradient was in the A soil horizon.

3. On southwest slopes of one soil type, the A horizon contained more moisture throughout the season than the upper 6 inches of the B horizon. On northeast aspects, however, the reverse was true.

4. Toward the end of the season the soil moisture content falls off much more rapidly on the southwest than on the northeast aspect. In May there was very little, if any, difference between

them. In September there were great differences.

5. Wilting coefficients are consistently higher on northerly than on southerly aspects, especially on dolomitic soils where the difference was 4.17 percent, a variation probably related to difference in sheet erosion and organic matter on the two aspect classes.

6. Percolation of water was much more rapid on northeast than on southwest aspects and on moist as compared with dry soil conditions.

#### Dolomite soil:

Northeast aspects	90.67 units
Southwest aspects	53.33 "
Moist soil	94.17 "
Dry soil	49.83 "

#### Shale soil:

Northeast aspects	130.8 units
Southwest aspects	45.5 "
Moist soil	105.3 "
Dry soil	71.0 "

7. The maximum surface soil temperature is correlated with aspect and with steepness of slope. The following table gives the season means for the 8 blocks. Although not shown in the table, there is a much more rapid increase in surface soil temperature as the season progresses on the southerly slopes than on the northerly. The table shows that soil temperature is closely correlated with steepness of slope on southerly aspects but not on northerly.

Relation between maximum surface soil temperature, aspect, and steepness of slope.

Block	Aspect	Slope	Mean	Days over
		steepness	temperature 1/	120° F
		Percent	Degrees F	Number
2 - 29	NE	58	101.0	0
2 - 28	E	41	104.7	13
5 - 2	NE	40	102.5	7
2 - 3	NE	37	100.9	0
2 - 33	SW	50	111.0	29
2 - 31	S	42	109.9	31
2 - 4	SW	28	101.2	5
5 - 3	SW	16	98.9	1

1/ Each value based on 120 daily block means.

8. By the use of multiple regressions, growth of shortleaf pine and yellow poplar by 10-day periods throughout the growing season was found to be correlated with current precipitation, available soil moisture, or both. Minimum relative humidity showed no significant correlation. Correlations between yellow poplar and precipitation and soil moisture were higher on south aspects than on north aspects on both dolomitic and shale soils. On shale soils the higher correlations were obtained between growth and precipitation; on dolomitic soils the better correlations were between growth and available soil moisture. No reasons for this are apparent at present.

### California

Root Pruning. Planting experiments in the brushfields of northern California have shown that the mortality rate for ponderosa pine 1-1 stock is highest in the first few weeks after planting when the water content of the soil is in excess of the wilting percentage. Root counts have shown that the usual methods of lifting and root-pruning nursery stock leave almost no root tips uninjured. Also, root-pruning experiments indicate that 20 or more days elapse after injury before new functional tips appear. These three observations led to a comparison of survival and ability to extract water from soil as between pruned stock and stock with uninjured roots.

Ponderosa pine seedlings, actively growing, were transplanted to typical forest soil in sealed cans -- half the trees with all root tips cut off and half with all root terminals intact. Equal numbers of trees were sealed in soil with moisture percentages 2, 4, and 9 percent above the wilting percentage for sunflowers. There were 144 trees in all, the 6 groups being arranged at random in 3 replications. Records now extend over 87 days.

The mortality rate for the root-pruned stock was 40 percent as against 19 percent for the stock planted without injury. The disparity was evident at all soil-moisture levels with the one exception that unwounded trees at the intermediate moisture percentage did not differ significantly from pruned stock.

Water use by the surviving trees with pruned roots was significantly less than by the unpruned trees during the first month; thereafter the pruned trees surpassed the unpruned trees in water used, but not to a significant degree. The disparity in death rates was greatest during the first month, when the pruned trees were unable to obtain as much water as the unpruned trees.

The practical difficulties of getting planting stock into the soil with at least some roots intact are great, but possibly not insurmountable. The study is being continued with a view to confirmation of results and tests of more promising means of application.

#### Central States

Due to a late spring season, field planting was not completed until May 1. Summarizing of results from previously established experimental series for inclusion in manuscripts was resumed in May.

#### Lake States

Root Pruning of White Pine Increases Field Survival. In June 1937 a bed of third-year white pine seedlings, at Hugo Sauer Nursery was thinned to several densities and root pruned at a depth of 4 inches to determine the possibility of obtaining satisfactory nursery stock for field planting without the necessity of using costly transplant stock.

In the fall of 1937 representative samples of this stock were planted on a silt loam soil. The site had a light overhead cover of aspen, 10 to 15 feet high, and was prepared for planting with a Killefer plow. The results of the field experiment, which are based on four replications of 200 trees for each treatment, are given below with a comparison of several age classes of transplants:

Age class	Density per square foot after thinning in spring third year	Treatment	Field survival (percent)	
			First year	Second year
3-0	25	Not pruned	56	48
3-0	25	Pruned at 4-inch depth	80	66
3-0	75	Not pruned	39	34
3-0	75	Pruned at 4-inch depth	68	54
2-1	--	Transplanted	90	69
1-2	--	Transplanted	92	75
2-2	--	Transplanted	94	94

It will be noted that root pruning, when combined with thinning, produced stock whose survival compared favorably with 2-1 stock. Considering the relative cost of producing transplants, as compared with root-pruned 3-0 stock, it would seem that root-pruned stock would be a

fairly good substitute for transplants if the field planting sites are not too severe, since the cost of root pruning is usually not over 10 cents per thousand, while transplanting costs for 2-1 stock will usually run \$1.00 to \$2.00 per thousand.

Dormancy of White Pine Seed. The germination tests recently completed by Roe on white pine seed collected on the Nicolet National Forest last fall appear to indicate that the characteristic delayed germination of this species is more than a matter of a dormant embryo.

Although the best germination, 72 percent in 46 days, was obtained from those subsamples which had been given the usual stratification of 30 days at 50 degrees F., seed which had been rubbed on an emery paper until the coat was broken and then stratified showed almost as good results and in a much shorter period -- 64 percent in 25 days. Moreover, the peak of germination was reached at 14 days compared with 22 days for the seed which was only stratified.

Additional evidence that an impermeable seedcoat probably plays a part in retarding the germination of white pine seed is furnished by the other treatments used in the test.

Treatment	Germinative energy		Total germination	
	Percent	Days	Percent	Days
None	48	34	52	59
Stratified 30 days at 50° F.	68	22	72	46
Scarified	58	27	61	59
Scarified and stratified for 30 days at 50° F.	60	14	64	25
Soaked in concentrated sulphuric acid for 5 minutes	59	27	62	59
Soaked in water for 24 hours	59	27	64	59

It will be noted that aside from the control and the two treatments already mentioned, there was a surprising similarity in results.

Since the particular lot of seed had been stored in the cones at a low temperature during most of the winter and therefore may have undergone some degree of after ripening during

storage, it is planned to repeat the experiment next fall with fresh seed which has not been exposed to low temperatures.

### Rocky Mountain

A total of approximately 4000 ponderosa pine, lodgepole pine, Douglas fir, and Engelmann spruce transplants were graded at the Monument Nursery this spring. These trees were segregated into four size-classes and within each size-class the root development was observed. Trees with poor roots included those whose root system was spindly, short, or otherwise poorly balanced in comparison with the top development. In the medium-large and large size-classes the percentage of trees with poor root systems was practically negligible; whereas, in the smaller classes trees with poor roots were common. The percentage of trees with poor roots in the two smaller classes is presented in the following table.

Size-class	Percent of trees with poorly balanced root system			
	Ponderosa pine 2-1	Douglas fir 3-0	Lodgepole pine 2-1	Engelmann spruce 3-1
Medium-small	20	40	0	9
Small	59	54	27	28

### Southern

Seed studies - Graphic expression in studies requiring transformations. Frequently the results of regeneration studies are in the form of germination percentages or of plantation survival percentages based on finite numbers of seeds sown or trees planted, and further complicated by the inclusion of values above 80% or below 20%. Under such circumstances it is customary to base analyses of variance on transformed values instead of the observed P values; many regeneration studies at the Southern Station have employed the transformation  $\text{Cos } \theta = 1 - 2P$ .

The rub comes in presenting the results clearly and briefly to a reader sympathetic toward but not intimately acquainted with, current statistical methods. He thinks in terms of germination percentages, and the presentation of values approaching 180 (theta value corresponding to 100%) is confusing. If the P values corresponding to the theta values for the various component parts of a complex design are presented, computing (in terms of P values) the fiducial limits for all the comparisons the reader may wish to make is a big job, and their tabular presentation is wearisome and confusing.

In the course of preparing an office report on an over-winter seed-storage study, Wakeley found a solution of the difficulty. First, a special grid was prepared, with theta values from 1 to 180 at equal intervals at the right, and the corresponding P-values opposite them at the left. The lines corresponding to P-values of 2% were inked in for the ranges 1-10%, and 90-100%; for the rest of the chart intervals of 5% were inked in. This gave a specialized grid of P-values somewhat analogous to the grid on probability paper.

On this grid bar diagrams were plotted, using the uniformly spaced right-hand scale of the grid and theta values derived from the analysis of variance. At a convenient point, also, were plotted two short bars the lengths of which, in theta-value units, corresponded to fiducial limits at the 5% and 1% level, respectively.

The end product is a bar diagram which gives at a glance the germination percentage for each treatment tested. With dividers, fiducial limits at 5% or 1% can be taken off the two short bars plotted for that purpose, and applied to the bar diagram proper to show whether any given treatment excels any other treatment by a significant amount. The variable spacing of the grid for P-values automatically takes care of the sliding scale whereby differences of 10% may be of no significance when germination centers about 60%, but differences of 3% or 4% may be highly significant when germination approaches 95%.

Planting - First thinnings in spacing plantations. The Station's principal study of plantation spacing consists of approximately 216 acres of longleaf and slash pine on the Palustris Experimental Forest, at spacings ranging from 4 x 4 to 13 x 13 feet. The experimental design is modern, with replications to provide for three thinning methods and a check, and for controlled burning as well as complete protection. These plantations are entering their sixth growing season.

At Bogalusa, La., the Station has 10 acres of spacing plantations 15 to 17 years old, including one acre apiece of 15-year-old slash 8 x 8, 6 x 6, and 5 x 5 foot spacing, averaging about 38 ft. high. During May, Wakeley and Muntz marked these older slash pine plantations for a thinning which should be even more valuable in developing technique for later work on the Palustris than for direct information on spacing and thinning.

Each spacing was considered separately, as there were no replications of original spacings and spacing is confounded with site. Each 1-acre square was therefore laid out in a latin square of nine 1/9-acre plots, to provide for two thinning methods and a check. The two methods chosen were that of the Gaylord

Container Corporation (successors to the Great Southern Lumber Co.) on whose lands the plantations lie, and one based on Bull's study of optimum spacing of slash pine in natural stands.

The Gaylord Corporation foresters thin 6 x 8 commercial stands 13 to 17 years old by removing 30% of the items by count, "regardless of survival to date." This method was applied arbitrarily to 8 x 8, 6 x 6, and 5 x 5 foot spacing, though the company foresters themselves recognized that it overthinned the 8 x 8 and underthinned the 5 x 5. The trees marked to cut were principally infected by Cronartium or deformed by wind and sleet.

The method based on Bull's tables called for leaving 375-475 trees per acre, depending upon degree of crowding prior to thinning; while it removed in general the same form of tree as the Gaylord method, its cut was increasingly more severe than the Gaylord as spacing decreased.

By either method, and especially by the method based on Bull's tables, the closer original spacings were easier to mark, gave a higher yield, and left conspicuously better trees at conspicuously better new spacing.

## SILVICULTURE

### Allegheny

Stand Improvement. Demonstration thinnings of 10 and 15-year mortality cuttings were completed on the Pocomoke State Forest in Worcester County, Maryland. Both 23 and 30 year old stands were treated by thinning from below, removing those trees which, according to available tables, are expected to die during a 10 or 15-year period. Cost figures will be determined to find out whether such stand improvement measures will pay for themselves. These demonstration plots will be of value to the Region Seven Sustained Yield Unit.

A working plan was prepared for an administrative study on harvest cutting in South Jersey. The proposed method involves cutting all except 20 to 25 seed trees per acre in a 55-acre oak-pine stand, piling and burning brush, and "double disk" using a 50 percent overlap.

Appalachian

Methods of Cutting Loblolly Pine Pulpwood. In the current study of methods of cutting in pulpwood-size stands of loblolly pine in the Piedmont and Mid-Atlantic coastal region, 5 cutting areas have been established. One of the objectives of the study is to determine the relative costs of harvesting under different cutting systems. The data collected on the cost phase of two of these areas have been partially analyzed.

Cutting area No. 4 is located on the Santee Experimental Forest in Berkeley County, South Carolina. Cutting was done by skilled labor paid on the piece basis, at the customary rate of 1 cent per pulpwood stick. Contractors in this vicinity figure that the cost of felling and bucking pulpwood averages about \$1.00 per unit and sometimes use this as a basis for the payment of labor. They estimate that a unit of average size pulpwood contains approximately 100 sticks, hence the payment of 1 cent per stick -- an easier method of payment than the unit basis since the wood need not be ricketed and measured.

Table 1 is a summary of the cost phase on cutting area No. 4. On this area there are 6 plots, each representing a different cutting system ranging from clear cutting (leaving 4 seed trees per acre) to a light thinning (in which only about 30 percent of the volume was removed). Data for each plot are presented to indicate the variation in costs due to different cutting systems and timber conditions.

Cutting area No. 5 is located on the lands of Johns-Manville near Jarratt, Virginia. In cooperation with this Station in conducting the experiment, Johns-Manville agreed to furnish the timber and the labor for cutting. The men, paid at the rate of 35 cents per hour, were fairly experienced in cutting pulpwood. Table 2 summarizes the costs on this area. Here also, 6 different cutting systems were used.

Computed on the piece basis, production costs were lower, and the wage earned by labor was greater on area No. 4 than on area No. 5. This difference is attributed to:

1. On area No. 4 the labor was more experienced.
2. Timber conditions were better on area No. 4; the stands were more open and the trees were taller. Even though the timber was larger in diameter on this area than on area No. 5, the normal increase in cutting time was offset by easier logging conditions.

3. Working on a piece basis on area No. 4, the men naturally worked faster. Furthermore, they were content to earn \$1.50 per day and would work at high speed for about 5 hours and then stop work early in the afternoon.

Production costs are closely tied up with the size of the timber cut. When the timber is relatively small in diameter:

1. Labor earns more per hour when paid on a stick basis.
2. Labor earns less per hour when paid on a unit basis.
3. Production costs are high when labor is paid on an hourly basis.

In each instance the reverse is true as the timber increases in diameter.

Thus, on area No. 4 labor earned well over 30 cents per hour, and on area No. 5, if labor were paid 1 cent per stick, the hourly wage would be slightly under 30 cents.

It must be noted that the cost figures presented here were obtained with experienced labor and represent only the effective working time under specific timber conditions and cutting systems. It is believed that these costs represent a rather high level of operating efficiency under present methods in the Mid-Atlantic region.

Table 1. - Cost of production on cutting area No. 4,  
Santee Experimental Forest

Plot no. 1/	Volume cut		Man-hours per unit 3/	Production cost per unit if labor is paid:				Hourly wage earned by labor	
	Units 2/	Sticks		30¢ per hour	35¢ per hour	1¢ per stick	\$1.00 per unit	1¢ per stick	\$1.00 per unit
	Number			Dollars				Dollars	
19	9.43	630	2.38	0.71	0.83	0.67	1.00	0.281	0.420
20	7.85	879	2.68	0.80	0.94	1.12	1.00	0.417	0.373
21	7.30	662	2.85	0.86	1.00	0.91	1.00	0.318	0.351
22	9.09	624	2.27	0.68	0.79	0.69	1.00	0.303	0.440
23	5.52	602	3.20	0.96	1.12	1.09	1.00	0.340	0.312
24	5.34	486	2.80	0.84	0.98	0.91	1.00	0.325	0.357
Average of all plots				0.79	0.92	0.87	1.00	0.330	0.379

1/ Each plot is 0.4 acres in area.

2/ A unit is 160 cubic feet of stacked, unpeeled wood.

3/ Effective time of felling and bucking trees into 5-foot lengths. Also includes time of walking from tree to tree and necessary swamping and other effective time.

Table 2. - Cost of production on cutting area No. 5,  
Johns-Manville, Jarratt, Va.

Plot no.1	Volume cut		Man-hours per unit3/	Production cost per unit if labor is paid:				Hr. wage earned by labor	
	Units2/	Sticks		30¢ per hour	35¢ per hour	1¢ per stick	\$1.00 per unit	1¢ per stick	\$1.00 per unit
<u>Number</u>				<u>Hours</u>				<u>Dollars</u>	
25	9.25	988	4.18	1.25	1.46	1.07	1.00	0.255	0.239
26	8.65	965	3.56	1.07	1.25	1.12	1.00	0.313	0.281
27	9.62	967	3.00	0.90	1.05	1.00	1.00	0.335	0.333
28	9.09	769	3.15	0.94	1.10	0.85	1.00	0.269	0.317
29	2.95	419	5.12	1.54	1.79	1.42	1.00	0.278	0.195
30	5.29	691	3.98	1.19	1.39	1.31	1.00	0.328	0.251
Average of all plots				1.09	1.27	1.07	1.00	0.294	0.275

1/ Each plot is 0.4 acres in area.

2/ A unit is 160 cubic feet of stacked, unpeeled wood.

3/ Effective time of felling and bucking trees into 5-foot lengths. Also includes time of walking from tree to tree and necessary swamping and other effective time.

### Central States

Soil Moisture Studies. Plans were made to get some preliminary information relative to the effects of the opening of stands on soil moisture at three periods throughout the summer, the first in May during the active growing season, the second in June after growth is over but before the drought period, and the third during July or August under drought conditions. Moisture content of the top 6 inches of soil will be studied under the various densities of overstory used in release study plots. These results will be correlated insofar as possible with the response of reproduction to release. The first series of samples have been taken on both forests.

Pine Distribution. Mapping of the distribution of shortleaf pine in Missouri was continued during the months of April and May. This preliminary work is scheduled for completion by July 1, 1940.

Silvics. The successional relations of natural reproduction on old fields within the boundaries of the Southern Illinois Experimental Forest is being observed in the 5-year remeasurement of reproduction plots this spring. Originally established to study rate of invasion of tree species from a typical mixed upland hardwood forest into adjacent fields, the seedling counts were made on

quadrats at one-chain intervals extending from within the woods in east, west, and northerly directions. The most evident change in composition of seedlings now established is found in the decrease of sassafras seedlings and the increase of yellow poplar seedlings, most pronounced immediately next to the woods. These changes after 5 years were apparent a distance of 20 chains, with diminishing density at the greater distances.

### Lake States

Jack Pine Reproduction Method on Timber Sales. One phase of research often slighted is the application of results. This Station has taken the position that it is not enough to write up and distribute a research report. We should, in addition, lend assistance in getting results into actual practice. We are, therefore, actively cooperating with the Chippewa National Forest in applying research findings relative to jack pine reproduction, to large timber-sale areas.

We find that no matter how well the Supervisor, timber-sales men, and ranger understand the principles, it is the laborers on the ground doing the work who actually determine the success of a job. In the slash scattering work in jack pine, the men are prone to do a good job of scattering branches but do not distribute those containing cones over the exposed mineral soil as well as they should-- and this is, of course, the essential feature. Zehngraff and LeBarron are therefore helping to install small demonstration plots on the ground to show just how they think the job ought to be done.

In actual practice, too, we are finding out that we should not expect natural reproduction throughout a timber-sale area. Where timber is scattered, the ground is occupied by brush in openings. In such places natural reproduction cannot be expected and planting will have to be done. Fortunately, the Athens Disk is a good tool for ground preparation prior to planting. This tool is being used, therefore, not only to scarify the surface for natural reproduction where seed can be assured, but also to prepare ground for planting--all in one operation.

Mortality in Selective Cuttings of Northern Hardwoods. The 5-year mortality check in the older cuttings at the Upper Peninsula Station was started late in May, just as the leaves were beginning to unfold. We find that to be a very effective time to make the check, since visibility is good while the leaves are still small, and once the buds have burst there is no doubt whether a tree is dead or alive.

In accordance with past practice we are making the mortality inventory of the entire cutting areas rather than just sample plots,

since it is our feeling that sample plots are altogether too small to convey the correct impression of mortality. Although the records have not been worked up, it seems fairly obvious from the field work that mortality will not be excessive for the period. It is confined mostly to breakage of very defective and decadent trees that were left and which, incidentally, should have been cut during the first logging operation. Proper attention to the removal of defective trees at the first cutting seems to be the answer to the mortality question. There was an occasional sound tree that was uprooted, mostly around wet spots and exposed locations. This is something that cannot be avoided except that precautions should be taken to leave as heavy a stand as possible in such areas.

Considerable mortality was observed in the virgin area among small suppressed trees 2 to 4 inches in diameter--much heavier than in cutting areas. The probable reason is the defoliation by canker worm in 1931-33 which weakened these small trees and caused them to die, for being in complete shade of a heavy overstory they did not recover from defoliation as well as trees on cutting areas.

Serious Sleet Damage to Cut Foot Experimental Forest. The sleet storm of early April on the Cut Foot Experimental Forest reported upon in the last bi-monthly report proved to be even more serious than at first thought. Large-crowned trees and large trees in general were not excessively injured but damage to slim trees of the intermediate crown class, pole stands, especially jack pine, and all understory trees, was extremely heavy. A tally of all sample plots for damage indicates that not over one-fifth of the cutting plots on the experimental forest are worth retaining for their original purpose.

Thanks to the efforts of the Supervisor and Ranger, salvage operations are progressing rapidly. Some seven timber operators employing about 40 men are at work on the experimental area, which is, of course, but a small part of the total area damaged in the Chippewa Forest. Only the most severely injured trees are being utilized at present in order to get over the whole area as fast as possible. It is fully expected that follow-up cuttings will be necessary later.

When salvage is complete there will be a good deal of clean-up left for the CCC to do. An effort will then be made to fill in the holes left in the stand, by scarifying to stimulate natural reproduction, and by planting.

Northern Rocky Mountain

Light cutting on Deception Creek Experimental Forest. Many of the 160-year-old western white pine stands on south-facing slopes within the Deception Creek Experimental Forest have shown an astonishing loss in merchantable timber during the last 10 years. Yet many trees in the stand are making a good rate of growth.

Last year we set about to harvest this loss, apparently caused mainly by beetles and Armillaria mellea, and convert the stands from a nongrowing to a growing condition. About 15 to 20 percent of the live merchantable white pine volume, made up of trees of poor form, slow rate of growth, and general unhealth, were removed in a regular timber sale operation from about 250 acres. This operation, involving 710,000 board feet, proved so practicable that we are continuing the cutting plan this year to include over a million board feet of pine from about 400 acres. Bids, which were received the latter part of May, ranged from \$1.05 to \$3.05 per M for white pine stumpage which was in addition to \$0.75 per M brush disposal and the building of 2.5 miles of new road and completing construction on 1.2 miles. Including road and brush disposal costs the high bid is equivalent to about \$8.00 per M, which is unusually high considering the quality of the material to be removed.

The light cuts have not only enabled us to salvage material which would otherwise be lost, but through them we are getting a utilization road system built on the experimental forest.

Light cuttings of this type, made possible only by utilization roads, hold real promise as a method to convert many of our older, non-growing white pine stands to a producing condition.

Pacific Northwest

Douglas fir. Progress reports were prepared by Isaac on two Douglas fir partial cutting studies, one in an extremely old but sound stand with considerable hemlock (Schafer Bros.), and the other in a moderately old but very defective stand with considerable hemlock also defective (Westfir). A cut of approximately 40 percent, most of which was sound Douglas fir, was made on both areas. The reserve stand left on both areas was in the neighborhood of 100 M feet per acre, gross volume. But on the first area about 15 percent of the reserve was classed as cull and the remainder as sound or part sound, while on the second area 52 percent was classed as cull and the remainder as sound or part sound. The extremely high percentage of cull in some of the overmature Douglas fir stands creates one of the most perplexing management problems in the type.

Ponderosa Pine. Before leaving for the field McKay prepared a report on the establishment of the seven methods of cutting plots at Pringle Falls, which show an interesting comparison between the so-called "thrift" and the so-called "value" methods of applying the maturity selection system of cutting.

Natural Areas. Another natural area, namely the 22 Lake Area on the Mt. Baker Forest, has been approved by the Regional Forester and the Director, now making eight areas in this region. It is typical of the hemlock-cedar of the northern Cascades. Eight other tracts representative of various types of virgin forest are also under consideration by the Natural Area Committee.

Stand Improvement. The CCC stand improvement projects on the Chelan and Wenatchee National Forests were inspected by Kachin during this period. In addition, a new plot, laid out in randomized design, to test the effect of crop tree release cutting in sapling pine and to serve as a demonstration area for training CCC stand improvement crews, was established on the Chelan.

Instruction in the technic of crop tree pruning and release cutting was given members of the University of Washington forest school camp at Klickitat, Washington.

Reconnaissance is being made of needs and opportunities for stand improvement measures in western white pine, sugar pine, and ponderosa pine second-growth types on the Rogue River National Forest and in Port Orford cedar-Douglas fir types on the Siskiyou.

An article describing the Hebo pruning club and its use was prepared for the Journal of Forestry.

#### Rocky Mountain

Natural reproduction in cut-over stands. A 10 percent stocked quadrat survey was made in conjunction with a yield study of cut-over stands of lodgepole pine to determine the distribution of natural reproduction following cutting. The age of the cuttings of the 85 one-acre plots on which the observations were made varied from 7 to 64 years and the reserved volumes varied from 1 to 10 M board feet.

From observation it appeared that the greatest amount of reproduction was obtained in stands where the crown canopy had been opened the most, and that the least reproduction existed under stands of dense canopy resulting from light cutting. Analysis of the data showed no relationship, however, between the total amount of reproduction and reserve volume in board feet of trees 10 inches d.b.h. and larger, or number of trees over 3.6 inches d.b.h.

in the reserve stand. Neither was there a definite relationship between percentage of area stocked with reproduction and reserve volume in board feet of trees 10 inches d.b.h. and larger, or number of reserved trees over 3.6 inches d.b.h.

Further analysis indicated a significant correlation between percentage of area stocked and basal area of the reserve stand 3.6 inches d.b.h. and larger and number of years since cutting. The multiple correlation coefficient obtained was 0.3626. Of considerable interest is the fact that percentage of area stocked with reproduction is negatively correlated with basal area of the reserve stand with a simple correlation coefficient of -0.2643, which is significant. The relationship between percentage of area stocked and number of years since cutting is positive with a significant correlation coefficient of 0.2235. Apparently, in cut-over stands of lodgepole pine the percentage of area stocked with reproduction decreases with an increase in basal area of the reserved stand; however, the percentage of area stocked with reproduction tends to increase with time since cutting.

It seems probable that the distribution of reproduction in a cut-over area is most closely related to the distribution of sunlight striking the ground. In the absence of data on light intensity it appears that the basal area of the reserved stand is the most useful factor in evaluating the extent to which a stand has been opened up to permit natural regeneration to become established.

#### Southern

Alabama Farm Forestry Project. The plans for this project were formulated in September, and formally submitted for approval in December. After the funds were approved at the end of February it was found that Swarthout would not be available for the job until the first of May. Since it was desired to complete, if possible, some work in Fiscal Year 1940, Bruce was assigned to the project April 4.

Because one of the most urgent problems in Central Alabama is the conversion of low grade woodlots into profitable stands of pine or pine-hardwood, it was decided to make a survey of the conditions that make possible adequate pine reproduction. The plot records were designed to make possible rapid plot tallies on which all recognized factors influencing pine reproduction were broken down into categories, each of approximately the same order of significance in its effect on pine reproduction. No plot boundaries were laid out, the sample being merely an area essentially uniform. No precise counts or measurements were made, the factors being thrown into categories by ocular estimate.

There were 115 plots taken in Tallapoosa County. Although at first glance all the summary of plots apparently does is confirm existing general ideas about the effect of fire, crown density, and competition

on pine reproduction, it is possible to run through the categories and make rather detailed statements for Tallapoosa County. To be reasonably certain of obtaining pine reproduction the following are necessary:

1. Three or more excellent seed trees per acre, or 5 or more fair seed trees per acre.
2. No concentrated grazing while reproduction is under 6 years old.
3. Less than 40% pine crown density (except in old-field stands where crown densities of 40-60% will allow satisfactory reproduction) provided there is little or no understory competition.
4. No severe fires, no moderate fires while reproduction is young, and no repeated burns.
5. Hardwood crown density of less than 15%.
6. Less than 20% of the understory occupied by hardwood reproduction and brush to the exclusion of pine.
7. At least, a moderately good seed year.

These results will be checked by a survey now underway in Autauga County (in the Upper Coastal Plain - Tallapoosa County is in the Piedmont Soil Province) and, when either confirmed or adjusted, should be of direct help to men responsible for the action program.

The results also indicated in these surveys will be used as guides in laying out pine reproduction experiments on some of the forest areas now being developed by the Alabama Experiment Station and included in cooperative agreement covering the Alabama Farm Forestry Research Project.

Silvics. A study of developing practical methods for eradicating or for reducing the scrub oak population on the Harrison Experimental Forest was started in 1939. A recent tally of the oaks treated by various methods in an attempt to kill them showed the following results:

<u>Mechanical treatment</u>	<u>Percent killed</u>
Cut above ground (6 to 18 inches)	13.6
Grubbing (digging out stem with part of root)	36.0
Girdling by fire from a blow torch at base of stem	16.8
Removing bark at base of stem	1.0

<u>Chemical treatment</u>	<u>Percent killed</u>
Injecting sodium arsenite into root	68.0
Injecting sodium chlorate into root	0
Injecting Atlacide into root	0
Injecting sodium arsenite into stem	68.5
Injecting sodium chlorate into stem	0
Injecting Atlacide into stem	0
Injecting pentachlorphenol into stem	0
Spraying whole tree with pentachlorphenol	20.0
Painting stumps with sodium arsenite	60.1
Injecting sodium arsenite into stump	61.0
Injecting pentachlorphenol into stump	0

SouthwesternHarvest Cuttings

Ponderosa Pine. In 1939, a 480-acre tract of ponderosa pine which had been logged 30 years previously was classified as to log grades. The 1909 cutting was by the Forest Service group selection method which removed 63.3 percent of the stand and left 36.7 percent, amounting to 3,521 board feet per acre. By 1939 the volume had increased to 5,939 board feet per acre.

The logs were graded by W. G. Thomson of the Region 3 Division of Timber Management, using the Pacific-Northwest system slightly modified to meet conditions in the Southwest. Results of the classification are summarized in Table 1.

Table 1. - Log grades as classified in standing trees before the 1939 cutting.

Log grades*	Number of logs	Percent of total number
1	86	0.49
2	387	2.20
3	1943	10.91
4	646	3.67
5	7849	44.54
6	6730	38.19
Total	17621	100.00

\* As defined in R3-S, Sales Policy Utilization letter of February 17, 1939.

Foresters will be impressed by the low percentage of logs in Grades 1 and 2, and the high percentage in Grades 5 and 6. Clearly, the improvement of grades is one of the foremost problems confronting foresters in the management of future stands.

This area was logged a second time in the fall of 1939. Three methods of marking were used. One of these placed emphasis on the removal of low quality trees which were dominating smaller trees of potential high quality. Blackjack groups, generally overstocked, contain surprisingly large numbers of slender stems 9 to 18 inches d.b.h. which have partially cleared their boles to a height of at least one log length. Cutting was directed toward releasing these trees. If nothing more is done, many of them will produce butt logs of Grades 1 or 2. Pruning at a cost of about 10 cents per tree will insure a substantial percentage of clear logs in the 4th and 5th cuttings 60 and 90 years hence. Trees now over 16 inches d.b.h. are considered too large to warrant pruning, unless situated in a position that may warrant holding to large size. Most of the remaining rough trees will be removed in the next cut, 30 years from now.

The best opportunity for pruning is in the dominants of the reproduction class. These trees are from 5 to 8 inches d.b.h. and are growing at a rate of 3 or 4 inches per decade. Left to themselves, they will become wolf trees of the class that is now being poisoned in stand improvement. If pruned within the next 5 years, they will produce good butt logs which will become available at the time the last of the old generation is being removed.

Douglas fir. In the spring of 1925 several permanent sample plots representative of different methods of cutting were established in the Douglas fir timber type on the Lincoln National Forest in New Mexico.

When these plots were remeasured for the third time in the late fall of 1939 <sup>1/</sup>, the trees were classified according to age and vigor, using the tree classification devised by Keen for ponderosa pine. This was done not so much with the view of determining whether Keen's classification was suitable as a guide to marking Douglas fir stands, as because it was felt that by classifying the trees in this manner the growth data could be analyzed better than on the basis of diameter classes. Although the stands contain species other than Douglas fir alone, namely Douglas fir, white fir, and limber pine, diameter growth of Douglas fir only is here reported. Furthermore, because trees in age class 1 and vigor class D, of all age classes, were very limited, data on these are omitted.

Table 1 shows diameter growth of Douglas fir by age and vigor classes on three plots, each of which represents a different <sup>1/</sup>. Although plots were not due for remeasurement until spring of 1940, the total growth period may be regarded as 15 years in that no further growth between fall and spring would have occurred.

method of cutting. Although the results indicate that diameter growth is quite consistently related to vigor and age of trees there is, as will be noted, considerable difference in the rate of growth of the trees on the different plots. This is in part due to differences in site but it is believed to be mainly due to differences in degree of release, caused by differences in the method of cutting. Of special interest are the results shown for the scattered seed tree cutting plot in that this plot contains a relatively large number of thrifty mature trees, many of which were well released. This method of cutting aimed to leave the best trees, regardless of size, in each group and cutting the rest. Most of the released trees in age class 2 are codominants, whereas those in age classes 3 and 4 are dominants. As will be noted, even the large dominants have made good growth. This is better revealed by the data in the right half of the table, showing the average growth of trees of each age class and also the corresponding growth in basal area. On the basis of the latter, the older and larger trees appear to have put on more growth than the younger and smaller trees. In terms of volume growth, the difference would obviously be even greater. Similar relations between diameter growth and vigor and between diameter growth and age obtain for trees on the other two plots, although not quite so consistent as on the scattered seed tree plot.

Table 1. - Diameter growth of Douglas fir trees in cut-over stands in relation to age and vigor. Based on 15-year record, 1925-40, of trees on permanent sample plots, Lincoln National Forest, New Mexico

Age class	Mean annual diameter growth-vigor classes			Number of trees			(a) Av. diam. (ABC)	(b) Av. diam. growth	(c) Av. basal area incr.	No. of trees
	A	B	C	A	B	C				
	In.	In.	In.	No.	No.	No.	In.	In.	Sq. ft.	No.
Scattered seed tree cutting plot (north slope)										
2	.283	.239	.105	10	3	6	15.3	.226	.0380	29
3	.228	.165	.104	4	12	7	25.0	.158	.0433	23
4	.144	.080	.047	8	5	1	37.2	.114	.0463	14
Diameter limit cutting plot (west slope)										
2	.216	.135	.123	14	9	9	14.4	.159	.0251	42
3	.128	.089	.034	10	12	6	19.4	.091	.0193	28
4	.033	.233	-	1	1	-	36.0	.133	.0523	2
Light selection cutting plot (south slope)										
2	.198	.133	.076	11	24	11	14.7	.135	.0214	46
3	.096	.193	-	3	1	-	21.3	.120	.0280	4
4	-	-	-	-	-	-	-	-	-	-

(a) Derived from average of total basal area for trees in each age class.

(b) Weighted average.

(c) Derived by first adding diameter growth to average diameter shown under (a) and then determining difference between corresponding basal areas.

The important fact determined by this analysis of diameter growth is that, like mature ponderosa pine, mature Douglas fir also makes good growth response after cutting, provided the trees are and remain thrifty.

### Silvics.

Application of chemical fertilizers to pinon trees. Preliminary tests of the effects of chemical fertilizers upon pinon nut production were begun early in April at the Walnut Canyon plot on the Coconino National Forest near Flagstaff, Arizona. Fifty-five mature pinon trees were used, in 5 sets of 11 trees each, the trees in each set being selected according to size and previous cone production. As a measure of past performance, the average length of 25 full-sized empty seeds of previous crops under each tree was determined.

Fertilizers tested were ammonium sulphate and calcium nitrate for supplying nitrogen and ammonium phosphate for both nitrogen and phosphorus. Each of the three fertilizers was applied to trees of each set selected at random in amounts of  $2\frac{1}{2}$ , 5, and 10 pounds to a tree. Thus, in each set 9 trees received fertilizers and 2 were left as controls. The chemicals were spread uniformly over the ground under the outer part of the crowns at distances between 4 and 12 feet from the trunks, raked in lightly, and were dissolved by the last spring rains in April and May.

The trees will have no cone crop in 1940. The number of very small cones of the 1941 crop still inside the buds in May 1940 is low. Results of the experiment, therefore, cannot be expected before 1942. The number of primordia of the 1942 cones, which will be formed winter buds in the summer of 1940, may be affected by application of the chemicals. If there is a cone crop in 1942, the different treatments will be compared with reference to total production of cones and seeds, number of good seeds per cone, and size of seeds.

### Washington Office

A new method for measuring soil moisture content. G. J. Bouyoucos and A. H. Mick have recently described <sup>1/</sup> an electrical resistance method of measuring soil moisture in situ under field conditions which should be of interest to nurserymen and forest researchers.

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<sup>1/</sup> G. J. Bouyoucos and A. H. Mick. An electrical resistance method for the continuous measurement of soil moisture under field conditions. Michigan State College, Agricultural Experiment Station, Technical Bulletin 172, 38 pp., April 1940.

The apparatus consists of a plaster of paris absorption block and a portable A.C. bridge operating at high frequencies to measure the resistance of the block. In practice, the absorption blocks are imbedded in the soil to be tested. The moisture content of the block varies with the "available" moisture of the soil and its electrical resistance varies inversely as its moisture content. Hence, block resistance is an index of soil moisture. Changes in salt content of ordinary soils do not appear to interfere with these measurements.

Moisture trends may be followed by merely noting the resistance readings. However, for accurate moisture determinations, the apparatus should be calibrated for each soil. Thus far, the approximate experimental error has varied from 1/10 of one percent to one percent.

This method of determining soil moisture has proved convenient and rapid since after the blocks are installed only a few seconds are necessary to determine the resistance. It is believed that it will give more accurate results than former methods and thus make possible a more thorough and accurate understanding of soil moisture dynamics.

#### FOREST PRODUCTS

##### FOREST PRODUCTS STATISTICS

##### Northern Rocky Mountain

Lumber census. During the last ten days in May, Whitney made a cleanup trip to obtain returns from sawmills which had not filed a census report for 1939. It is expected that all returns will be on their way to the Washington office by June 15.

Wholesale lumber prices. Recent lumber prices compiled by the Division of Forest Products appear below:

Wholesale lumber selling prices

(N.E. Washington, Idaho, Montana)

	Annual 1939	1st quarter 1940	April 1940
Idaho white pine	30.36	31.84	32.76
Ponderosa pine	24.32	27.76	26.89
Larch-Douglas-fir	18.93	19.74	20.27
White fir	15.72	18.42	19.82
Engelmann spruce	20.01	22.44	22.25

Pacific Northwest

Lumber Census. To date 1,633 approved schedules have been sent to Washington. There are about 600 operators listed that have not been heard from. Many of these are no doubt nonexistent and many are small independent and contract loggers. Johnson will spend the month of June in the field contacting delinquent concerns and also those whose schedules are incomplete.

## TIMBER HARVESTING AND CONVERSION

Northern Rocky Mountain

Ponderosa pine utilization study. For two weeks in May, Rapraeger was loaned to Region Four (Ogden) to assist in making a sawmill study at the Boise-Fayette Lumber Company sawmill at Emmett, Idaho. Four hundred ponderosa pine logs were followed through the mill and the amount and kind of lumber obtained from logs of different sizes and grades determined.

Lumber manufacturing costs. The cost per thousand of manufacturing lumber in the band sawmills of the region was lower in 1939 than 1938, due to higher production which had the effect of decreasing shutdown expense. Below is a tabulation comparing the costs for certain white pine and ponderosa pine mills for the years 1938 and 1939, respectively.

Year	Total cut M feet	Manufacturing cost per M - dollars			
		Pond to planer	Planer to car	Over- head	Total
<u>Idaho white pine mills</u>					
1938	329,866	5.40	5.70	4.30	15.40
1939	398,560	4.67	5.32	3.78	13.77
<u>Ponderosa pine mills</u>					
1938	64,594	5.31	4.89	3.79	13.99
1939	184,746	4.96	3.72	2.72	11.40

Pacific Northwest

Pine Mill Studies. Sales realization expectancies, milling costs, and pond margin values have been developed for the logs studied at the J. Neils Lumber Company, Klickitat, Washington, during January and February of this year. An office report has been prepared and submitted to the cooperating company. Some of the data obtained during the study, especially those pertaining to green grade recoveries and to the changes occurring between rough-green and surfaced-dry, have yet to be compiled and analyzed.

During this study each log was graded in accordance with the R-6 system of ponderosa pine grades used in previous studies and in accordance with the newly proposed system resulting from the Inter-regional Log-Grading Conference of last November. The results were rather unexpected. The new system gave a less uniform division of the spread in values per M foot than did the R-6 system. Besides, the new system showed approximately \$0.40 per M less spread in value between small low-grade logs and large high-grade logs. The differences are best illustrated by the accompanying summary of the value of 20-inch and 40-inch logs.

Comparison of Differentials in Values per M Feet,  
Shipping Tally, between Grades

R-6 System

	20" diam.	40" diam.
Grades 1 and 2	\$2.75	\$5.70
2 and 3	2.85	5.60
3 and 4	0	--
4 and 5 (or) 3 and 5	1.20	1.80
5 and 6	1.70	1.35
Total Spread	\$8.50	\$14.45

<u>New System</u>	<u>20" diam.</u>	<u>40" diam.</u>
Grades I and II	\$4.55	\$9.50
II and III	1.15	1.90
III and IV	1.75	1.30
Total Spread	\$7.45	\$12.70
Grade IA and IB	1.50	2.90
IB and IIA	3.05	6.25
IIA and IIB	1.30	4.30
IIB and IIIA	.40	--
IIIA and IIIB (or) IIB and IIIB	.40	.70
IIIB and IV	1.45	1.30
Total Spread	\$8.10	\$14.05

Selective Timber Management in Ponderosa Pine. Brandstrom spent about a month on detail in Region 4 on a cooperative study of the operations of the Boise-Payette Lumber Company of Boise, Idaho. Aided by Logging Engineer Mason of Region 4 and Mr. McGregor of the staff of the Boise-Payette Lumber Company, he undertook a stand structure analysis of approximately 100,000 acres of ponderosa pine timber in which the company will be operating during the next five years. Four hundred  $\frac{1}{4}$ -acre sample plots were inventoried, and some 2,000 sample trees, mostly ponderosa pine, were measured for d.b.h., classified according to Keen's tree classes, and log graded. In addition, a small mill study test, under the direction of Rapraeger of the Northern Rocky Mountain Station, was made for the purpose of testing available log value data for certain types of logs. The immediate purpose of the study as a whole is to determine the relative values of the "cut" and "leave" trees under the company's present selective cutting practice as a basis for adjusting the company's timber depletion setup in accordance with the system worked out by Wohlenberg of the Division of State and Private Forestry, which system has gained the approval of the Income Tax Division of the Treasury Department. Another important purpose of the study is to determine whether the company's present cutting practice may need to be revised in the light of the cost and value data obtained in this study, and particularly to explore the possibilities for leaving a heavier reserve stand.

## WOOD PRESERVATION

### Pacific Northwest

Preservatives. The scheduled binnial inspection of the experimental sections of arsenic-paste treated telephone lines in Oregon was made during May. On the 7 lines subjected to their third inspection there was no change. In poles which showed decay in 1938 there has been no detectable advance of the rot; no additional poles evidenced decay. The two special lines installed with alternate treated and untreated poles are showing the effect of the preservative, though they have been in service only  $2\frac{1}{2}$  years. A Douglas fir line near Grants Pass, Oregon, shows no decay in the treated poles, but 44 percent of the untreated checks show sap rot or a softening of the sapwood, which is the first evidence of decay. The lodgepole-pine line near Prairie City, Oregon, shows no decay in the treated poles. Two of the untreated poles, however, are so badly rotted as to necessitate replacement within a year, and 14 percent show at least the first evidences of sap decay. What was concluded to be erratic behavior of the arsenic-paste in past years is now surmised to be attributable to differences in application of the preservative, but this surmise cannot be confirmed until the poles are removed from service.

## FOREST AND RANGE INFLUENCES

### FLOOD CONTROL SURVEYS

### Allegheny and Northeastern

Allegheny. A statistical analysis was made of the snow data, which had been collected on the Allegheny River Watershed during the past winter to determine the accuracy of the existing data and to improve the sampling methods for future surveys. A comparison of 50 snow samples taken under hardwood cover with 50 snow samples from a coniferous area indicated that there is a greater variation in snow depth and moisture content under a softwood stand. From the analysis of these data, the collection of 75 samples will be needed in a hardwood area to measure differences in water content from day to day that will be accurate to 0.1 inches. A similar number of samples under a hemlock area will result in an accuracy of 0.2 inches. Where the comparisons are to be made between small watersheds of different cover, it is planned to have at least 15 stations per watershed with five snow samples to be taken at each station. With this procedure it will

be then known that any reduction in water content on the water-sheds will be due to snow melt rather than to errors in sampling.

Snow studies were intensified on the Allegheny National Forest in the period of rapid melt which occurred March 7 to April 3, and the following facts were noted:

1. At the start of the period of rapid melt there was from 25 percent to 30 porcent more accumulated snow in the forest than in the open.
2. There was a definite time lag in the melting of snow under forest conditions and the run-off was less per day, despite the greater water accumulation. The forested watershed lost 1.9" of water during the period of rapid melt while loss on the open watershed amounted to 3.1".

The run-off from forested areas was from 3 to 4 days behind the open areas, a lag of sufficient length to show possible benefit in planning flood control for this region.

Merrimack. The Army Engineers' revised report on the Merrimack Watershed, just received, contains a number of changes, some of which may require recomputation of tables and possible revision of conclusions and remedial proposals in the Department of Agriculture report. The two reports are being checked to determine how much work will be necessary to bring our report into line with the new data given in the Army Engineers' revised report.

Connecticut. The revised Army Engineers' Connecticut River report, which has just been received, shows sufficient local damages remaining after the installation of the Army Engineers' projects to justify a Department of Agriculture survey. On the basis of hydrological, meteorological, and damage information available in the Army Engineers' report, from the State and from local agencies, the Working Committee has concluded that a detailed survey is feasible rather than the attenuated investigative stage considered prior to the availability of the Army Engineers' report. Establishment of tables of run-off coefficients for several cover types, including good and poor forest, and tables showing crop losses due to erosion combined with local investigations carried on by the Connecticut Survey party, influenced the Working Committee in their decision to recommend completion of the detailed survey.

The results of the snow studies on the Connecticut River have not yet been completely analyzed and written up, but some interesting conclusions are anticipated on the effect of forest cover on soil freezing. Conditions on the Connecticut were unusual during

the past winter in that there were from 3" to 18" of frost penetration before the first snowfall. Next winter's studies will give added attention to frost penetration since it is the opinion of the survey party that this factor is of great importance in promoting flood conditions on the Connecticut River.

Pequest. The Pequest preliminary examination was thought ready for the Working Committee early in April. However, recent developments in the hydrology section of the report have caused further delay. The New Jersey State Water Policy Commission are making a detailed study of the flood damage areas (Great Meadows muck farms) and have established temporary gage readings in the area to establish relationship between discharges in the meadow area and the U. S. G. S. gage at Pequest Furnace farther downstream. Those records are being analyzed to establish this relationship and will be included in the Pequest report as soon as they are confirmed.

Schuylkill. Action on the Schuylkill has been quiet because of the pressing needs of other matters. However, a field trip was made to study vegetation on the anthracite rock banks in the upper regions of the Schuylkill watershed. It is quite surprising to find so many forms of vegetation coming in, despite the poor condition of the soil structure on these banks. It was found that on older refuse banks (75-100 years) the pH values were nearly neutral and there was a wide assortment of the lower forms of vegetation that are of the earlier ecological succession. Many species of tree form were observed but not of very dense cover, except for the gray birch. It was noted that gray birch, while plentiful on some banks, was conspicuous by its complete absence on other banks. The inclusion of low water flows in the study is not contemplated at this time.

#### Field Staff Conference

A conference of Forest Service regional staff and field personnel from the Allegheny, Upper Susquehanna, and Connecticut Surveys was arranged for May 20 and 21 at Philadelphia. Directors Behre and Shirley were present, and Dr. Normal Curtis, Senior Representative for the S.C.S. on the Connecticut Survey, attended in order to broaden the outlook and allow for possible divergence and clarification in viewpoints. The meeting provided an opportunity for field and regional staff members to become acquainted with personnel and problems of other surveys.

The agenda included:

1. Present status of flood control surveys.
2. Snow survey procedure, methods, and equipment. Tentative results on each survey. Methods for correlating with hydrology.

3. Infiltration. Plans for this season. Soil moisture determination. Procedure, equipment. Methods for correlating with hydrology.
4. Cover conditions. Necessity for and intensity of survey. Methods possible and data available. Correlation with hydrology and survey objectives.

Harold Morey, Forester on the Connecticut Survey, gave a preliminary report on a study of the correlation between precipitation, cover, and run-off on the middle branch of the Westfield River, a west tributary of the Connecticut River. This stream, which has fairly complete precipitation and flow records for about 30 years, has had a change during the past 20 years from approximately 40 percent forest and 60 percent agriculture to approximately 60 percent forest and 40 percent agriculture. Despite an increase in the precipitation cycle, there appears to have been a slight decrease in run-off as the forest land increased. Full information will be given the field as soon as the study is completed, which should be within the next few months.

Dr. Curtis of the S.C.S. reported on a proposed short cut sampling method for infiltration tests. Briefly, this calls for selection of one or, as suggested by Director Shirley, two soil types on which all cover types occur. As an example (see illustration) with 6 cover and 5 soil types there would be 30 units to sample, and with 3 samples on each cover and soil type there would be a total of 90 samples. Taking 3 samples on Merrimack and 3 on Colrain from each cover type a total of 36 would be required. Sampling hay on the other soil types should show if the trends for the cover types are the same on all soil types. In all, not more than 45 samples should be necessary. If this is not the case, the full number of samples should be taken with no more labor than would have been necessary if that had been the original procedure.

SOIL TYPES	Merrimack -	x	x	x	x	x	x
	Hinckley -	x					
	Berkshire -	x					
	Gloucester -	x					
	Colrain -	x	x	x	x	x	x

Hay Cultivated Pasture Forest Brush Pasture  
Forest

COVER TYPES

AppalachianPreliminary Examinations

The preliminary examination report on the Big Sandy River watershed was completed during May. The preliminary report for the Little Kanawha River watershed in West Virginia was also completed in first draft. A preliminary examination of the Roanoke River watershed in Virginia and North Carolina has been authorized and intensive work will be started in the latter part of June or early in July. Some advance work, including a review of Army reports and data and participation in a public hearing, was done on the Roanoke watershed during the past year.

Survey Work Outline and Advance Studies. During May a plan for an advance study on the New River in North Carolina, Virginia, and West Virginia was prepared. The advance study is proposed at this time in lieu of the Survey Work Outline. Reconsideration of all the facts available indicated the advisability of revising and strengthening the preliminary examination report on this watershed before undertaking a complete flood control study.

Watershed Surveys

Flood control survey activities on the Potomac River watershed, with a few exceptions, are progressing according to schedule. During the past two months a number of installations for hydrologic studies on small watersheds were completed and a number of others will be installed in the immediate future. All of the other phases of study on the project are either going according to schedule or are somewhat ahead of time. In general, the over-all progress is about as scheduled. Similar progress is being made on the Pee Dee River Survey, in which the Station is cooperating.

California

Preliminary Examination Reports and Survey Work Outlines. During April and May work was resumed on the preliminary examinations of the Walker River basin of about 4,000 square miles, the Santa Ynez River basin of 900 square miles, the Santa Clara River basin of 1,620 square miles, and the Russian River basin of 1,670 square miles. The Walker River and Santa Ynez River examination reports have been written and are now in the hands of the Field Coordinating Committee for final field review. Field work has been completed for the Santa Clara basin, and that for the Russian River is 50 percent complete.

A survey work outline for the Salinas River (4,980 square miles) is also being reviewed by the Field Coordinating Committee. This outline is the fourth of six authorized outlines that have been completed for

California. Previous outlines have included the Pajaro, Santa Maria, and Kings-Kaweah-Tule-Kern River basins, comprising approximately 15,300 square miles of watershed area.

Pajaro Watershed Survey. Although the survey did not start officially until February 1, considerable preliminary work on sizing up watershed problems and on survey organization was handled beforehand by the project leader, assisted part-time by the senior representatives of the three bureaus of the Department engaged in the survey. Field work for the collection of basic data on the agricultural and mountain area is about 30 percent complete, and the damage surveys by the economists are nearing completion.

Central States

Committee Area 4 (Chairman - Soil Conservation Service, Dayton, Ohio.)

Muskingum River Detailed Survey. The Working Committee reviewed the Raccoon Creek unit report at Mt. Vernon during the week of April 22. This small drainage is representative of the glaciated portion of the Muskingum drainage where, in the opinion of the survey party, an agricultural program will contribute the maximum of flood control benefits. Field work for the entire Muskingum Survey has been completed and the party is engaged in preparing the final report, which will be due in Washington September 1.

Wabash River Detailed Survey. The work outline for the Wabash Survey has been submitted to Washington and it is hoped that approval will be received for the initiation of this survey by July 1. Because of the siltation problem in the upper reaches the survey work should be started on the main river and tributaries above Logansport.

Scioto River Preliminary Examination. A field reconnaissance of the Scioto was made early in May. About one-fourth of the drainage area lies south of the line of glaciation and except for extensive bottomlands is rough and rolling and well timbered. Several State forests and a considerable portion of the Wayne Purchase Unit are within the watershed boundaries.

Committee Area 11A (Chairman - Forest Service, Central States)

Hatchie River Preliminary Examination. Field work on the Hatchie Preliminary Examination has been completed and the report should be submitted to Washington about July 1. The problems on the Hatchie are somewhat similar to those on the Little Tallahatchie, except that destructive erosion still can be checked before the agricultural base has been entirely lost. Floods on the fertile bottomlands

can be remedied only by a combination of watershed control and drainage. Excessive maintenance costs of drainage enterprises make erosion control on the uplands a necessary first step.

Cumberland River Preliminary Examination. Progress on this Preliminary Examination has been delayed to permit work on the Hatchie in conjunction with the Corps of Engineers. A reconnaissance of the upper reaches of the river has been made and two public hearings have been held. With the completion of the Hatchie on July 1, necessary field investigations will be initiated.

Committee Area 14B (Chairman - Soil Conservation Service, Milwaukee, Wis.)

Little Sioux River Detailed Survey. This survey was authorized about May 1, and will be under way about June 1. The watershed is largely in prairie and it is not expected that forestry will play a very important role in any program for flood control.

Chariton River Preliminary Examination. This Preliminary Examination is nearing completion and should be submitted to Washington prior to July 1. The watershed drains a large area of submarginal and abandoned farm land south of the flat corn lands of central Iowa. Forestry will become of increasing importance in this watershed.

Iowa River Preliminary Examination. This Preliminary Examination is likewise about complete and will be ready for submission at an early date. It runs through fertile Iowa corn land and, as on the Little Sioux, forestry will not play a very important role in any program of watershed control.

Moramec River Preliminary Examination. Because of the high local interest in this watershed and the possibilities for effective cooperation with the Missouri Planning Board in its study of the watershed, an intensified Preliminary Examination has been authorized and is underway. Since the watershed is heavily timbered and contains several National Forest Purchase Units, the major responsibilities for the preparation of the report will rest with this Station. Conditions on the Moramec are similar to those on the St. Francis, except that the bottomlands are broader and generally more fertile. Damages are considerably higher, especially to recreational developments on the lower reaches near St. Louis.

#### Intermountain

Sevier Lake Watershed. Field headquarters for the Sevier Lake Watershed Flood Control Survey were established in Richfield, Utah, during the past month. Senior representatives and a portion of the

other technicians from each of the three cooperating agencies, have reported for duty and are now engaged in the preliminary phases of the survey, including survey planning, damage appraisal, watershed classification, and hydrology.

Initial efforts on the survey of necessity are centering around the development of a satisfactory scheme of watershed classification. This has been found to be necessary because there are about 300 flooding or potentially high hazard tributaries within the 15,000 square mile watershed area. It is hoped that this large number of tributaries can be classified into a relatively few broad groups from each of which one or two sample areas will be selected for intensive study. A diversity of plant cover, soil, and topographic conditions adds much to the difficulty of the classification job.

Streamflow records are almost entirely lacking except for short-time records of a very few tributaries. It is planned to overcome this deficiency of hydrologic information through installations in the headwaters of Ephraim Canyon near the Great Basin Branch Experiment Station, where it is proposed to install stream gaging stations on a number of small tributaries, each representative of different physical conditions.

#### Lake States

Watershed Surveys. Members of the staff have been engaged for some months on two surveys, as well as one preliminary examination report, covering the Kickapoo, Whitewater, and Black River watersheds. These studies have proved somewhat "baffling" for they are borderline cases with respect to the feasibility of instituting agricultural control programs.

As the Kickapoo survey report, under our chairmanship, is nearest completion, it may best be used to illustrate the type of problem which has kept us swaying between optimism and extreme pessimism for several months.

First, the seven years' records of runoff and erosion which have been accumulated at the Upper Mississippi Soil Conservation Experiment Station, near the Kickapoo, leave little doubt that, if agriculture could be sufficiently curbed on the Kickapoo, or any of the watersheds of that section which are similar to it, floods on the Kickapoo would be eliminated insofar as any important damages are concerned. The physical setup is perfect. The soil has high infiltration capacity when properly covered by vegetation, and it has enormous storage capacity. We can say that the only time a flood, of the present day type, ever could have developed in the natural condition of this watershed was in

one spring thaw every five or six years, when the ground and ice conditions were especially bad.

But agriculture in this region cannot be greatly curbed without making paupers of thousands of dairy farmers who are doing very well at present. A little can be accomplished, and quite positively, on the plowland area of each farm, by encouraging more alfalfa hay and less corn silage for winter feed. This is good business for the farmer. More land is being used for crops now than is needed. A lot could be accomplished on pastures if farmers could be persuaded to renovate and fertilize them, without increasing the present number of dairy cattle or other stock. But, naturally, the farmer will ask why he should invest 12 to 15 dollars in pasture improvement if he cannot harvest more grass from the area. And here is where the big "rub" comes, for, while the feed will be there if he does improve the pastures, we do not know whether this improvement would result in any material benefit to runoff, if that feed is utilized anywhere near as closely as the farmers of this region have been in the habit of utilizing their pastures. This is the point at which the runoff data from the La Crosse Station break down; in fact, on all phases of pasture runoff the Station has been particularly weak. Even if pasture improvement with proportionately heavy utilization has a mildly beneficial effect as we now think, certainly the flood control benefits will hardly pay interest on the investment which the farmer has to make to obtain taller and ranker grass, and give practically no "toe hold" for any attempt to regulate grazing.

What, with the agronomy and economics experts trying to formulate a plan for the Kickapoo which will insure greater income through more feed production and utilization, and the Forest Service convinced that the number of cattle must be reduced if we are to obtain any substantial reduction in runoff, the outlook is not good. We even feel that the advisability of keeping the cows out of 35 percent of the area, which in the past has been used as low-grade pasture more or less controlled by trees, may be questioned, since this will result in the concentration of an equal or perhaps an increased number of cattle on a smaller area.

#### Pacific Northwest

Walla Walla Watershed Survey. A comprehensive work outline describing in considerable detail the methods governing the conduct of the survey has been prepared and submitted to the Field Working Committee. The Forest Service personnel has been selected and is now on the job. It consists of Wallace Robinson, Senior Representative, Chandler Jenson, Assistant, Orville Cary, William Allyn, and Donald Peters. Field work is expected to commence June 1.

Preliminary Examination Reports. The Umatilla report is in the final stages. Considerable work has been done on the Yakima, Tillamook

Bay Region, Rogue, and Snohomish reports.

Stream Regimen Subcommittee. The NRPB established a subcommittee on stream regimen to make an inventory of existing information pertinent to this subject, together with deficiencies and recommendations for remedying these. Wyckoff is the Forest Service member on this subcommittee. Representatives of the various agencies interested in this subject met on April 23 with Mr. Bessey and agreed that each should submit a statement covering their activities and facilities related to water. This would include regional organization, bibliography of published and unpublished material, very brief description of studies now being conducted, and maps showing location of meteorological and hydrological stations and other useful data. We will submit a map showing the location of year-long headquarters stations. These will be helpful when conducting studies in the isolated parts of the region. During May, Bolles spent considerable time on the Forest Service statement for the stream regimen subcommittee.

Meetings. Chapler and Wyckoff attended several meetings at Walla Walla in connection with the Walla Walla survey. Other members of the Station and representatives from the Regional Office attended a meeting in late May to discuss the work outline. Chapler also represented the Department of Agriculture at a flood control hearing on Neskowin Creek on May 21 and a rivers and harbors hearing on Yamhill River on May 31.

#### Southern Station

Preliminary Examinations. The flood control survey personnel have participated in four preliminary examinations, two of which are under chairmanship of the Forest Service. The Forest Service has made its initial contribution to the Upper Red River preliminary examination report, which is being prepared under the chairmanship of the Soil Conservation Service. Preliminary plans have been made for the Brazos River preliminary examination, also under Soil Conservation Service chairmanship. Noteworthy in relation to this examination is the considered plan to have a reasonably comprehensive reconnaissance damage appraisal made, which will be followed, if warranted by the appraisal, by other field work in which all cooperating bureaus will participate.

A rough draft of the Marmontau River (La.) preliminary examination report has been prepared. This report probably will recommend that no survey be made; it is apparent that there is very little flood damage preventable by upstream flood control in the basin.

Work is continued on the Tombigbee River report.

Watershed Surveys. The Concho River survey report, prepared under the chairmanship of the Soil Conservation Service, was reviewed and, at the request of the Flood Control Advisory Committee, was submitted to Washington, although not approved by the Field Coordinating Committee. This is mainly to provide a review of the hydrologic section of the report by the Washington hydrologic group, after which it will be returned to the field for final revision. The Station assisted in the preparation of the Middle Colorado River survey cutline and is participating in that survey, which is under Soil Conservation Service chairmanship. The preliminary phase of the survey is almost complete. The importance of range in this watershed has led to the request for an additional Forest Service range examiner. The Lower Arkansas River survey, also under Soil Conservation Service chairmanship, is proceeding slowly; the work cutline is still in the process of preparation, although several months of the survey are past. On the other hand, the Neosho-Grand survey, under Soil Conservation Service chairmanship, is making rapid progress. The survey of forest and range land under immediate supervision of the Forest Service representative is progressing satisfactorily.

The Yazoo survey, under Forest Service chairmanship, is being held up somewhat, after a good start, by revision of the Little Tallahatchie report. Considerable revision is being made of the hydrologic-damage sections of the report, involving some field work; the results of those additional investigations will be, of course, more or less applicable to the Yazoo survey. The Upper White River survey is progressing satisfactorily. There appears to be a limited amount of flood damage, but there may be an opportunity for application of an effective but low-cost action program, owing to the fact that the headwater area of the stream is largely forested.

#### INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW

##### Appalachian

Runoff from Coweeta Streams. The base flow of Coweeta streams on April 1, 1940, was the lowest April 1 record since the area has been under observation. The flow from drainage area no. 13 was 1.6 cu. ft. per sec. per sq. mi., compared with 5.0 in 1939, 3.0 in 1938, 2.8 in 1937, and 5.0 in 1936.

For the four months prior to April 1, 1940, the precipitation on area no. 13 totaled only 19.94 inches, whereas during the same period in 1939 the total was 35.54 inches.

Since in 1939 (from April 1 to December 1) stream no. 13 ran off 15.47 inches during a summer season of subnormal rainfall, and evaporation and transpiration losses in addition may exceed that amount, it appears that storage may be drawn on rather seriously in the months to come.

If the summer rainfall for 1940 should be below normal, it is to be expected that the Coweeta drainages will experience a shortage in their normal water balance.

Meetings. From April 15 to April 20 a Forest Influences Seminar was held at the Coweeta Experimental Forest to discuss theories on standardization and proposed changes in land use on the various experimental watersheds at Coweeta. The meeting was called in accordance with the decision made at the San Dimas meeting about a year ago, when it was agreed that before any major land use treatments or changes took place Forest Service representatives from different parts of the country should be called in for consultation.

The party left Asheville on Monday morning, April 15, and made a brief study of streamflow experiments being conducted on the Bent Creek watershed and were permitted to see a typical cross-section of the roadbank stabilization experiments that the Station is conducting on this area. On Monday afternoon the party drove from Bent Creek to Coweeta, stopping at different points along the highway to observe land use practices. Discussions covering several days at Coweeta were condensed and summarized into two committee reports: one on standardization and the other on cover treatments. After the Coweeta meeting some of the visitors were driven to the Copper Basin watershed to inspect the experiments being conducted in this area near Copperhill, Tennessee.

Committee on Standardization. The committee on standardization\* was charged with a critical analysis of the research methods in hydrology in use on the Coweeta Experimental Forest. Emphasis was placed upon the validity of selected criteria for the standardization of watersheds and upon the adequacy of analytical methods for expressing these criteria. The committee also discussed experimental techniques in hydrology.

Standardization criteria approved for use included peak discharge, base flow (groundwater) depletion curves, runoff-precipitation ratios, flow duration curves, seasonal groundwater runoff-effective precipitation ratios ( $\frac{GRO}{EP}$ ), and unit yields. Of these, one of the most important criteria  $\frac{GRO}{EP}$  was believed to be the  $\frac{GRO}{EP}$  ratio and its further development was recommended. Diurnal fluctuation, storm flow, and groundwater (well measurements) were thought to have value in analysis but further study was recommended before their use as any sort of criterion of watershed standardization.

\* Standardization of a drainage area is defined as the process of obtaining adequate records of performance on which future comparisons may be based.

Experimental techniques which this committee discussed included improvements on local installations. Elimination of evaporating pans, except where needed for special studies and at a central meteorological station, were recommended. Perhaps the most important recommendation was that the various stream gaging stations be thoroughly inspected and all necessary additional measures for their protection during the maximum expected flood be undertaken immediately. This fact was brought home in a timely manner by the occurrence during the conference of a four-inch storm which kept several delegates busy piling sandbags.

The committee on cover treatments was charged with the responsibility of deciding whether cover changes should be made in accordance with local practice or in accordance with a more fundamental approach to the study of the hydrologic cycle. The Station has felt that a fundamental approach is the more desirable and probably the more expedient in the long run. However, the program of the various public and private agencies demands a certain amount of information from empirical tests.

Of some forty individual drainages on the Coweeta area it is planned to leave at least half of the watersheds as checks. Of the watersheds to be treated the committee seemed to think that it would be better to determine basic principles of water and soil conservation.

The committee listed the following objectives of watershed management:

1. Protection against floods.
2. Uniformity of flow (e.g., for hydro-electric power).
3. Soil erosion prevention and control.
4. Maximum total yield of water.
5. Maximum summer yield of water.
6. Maximum usable yield of water (e.g. for municipal and industrial uses--"usable" implies requiring only moderate expense for desilting and purification).

Of these the committee felt that objectives 1, 2, and 3 might be grouped together; that 4 and 5 probably were of little significance in the Southern Appalachian territory; and that No. 6 was the objective more likely to be sought than 4 or 5. The treatments suggested to serve the various objectives are as follows: undisturbed forest (check) managed forest, grazed forest (browse), grazed and burned forest, improved pasture, overgrazed pasture, rehabilitation, barrier storage, commercial exploitation, progressive exploitation (hill billy), periodic burning, periodic clear cutting, mountain farming, pumping.

CaliforniaSan Dimas Experimental Forest

Precipitation. The precipitation during the season of 1939-40 has been of a rather interesting nature. It started with a heavy tropical storm on September 24-26 which, although not actually within the hydrologic year (October 1 to September 30), had to be counted as part of the seasonal total as its effect would extend well into the year. The next storm of any consequence occurred on January 7 and was marked by very heavy intensities of short duration only. The balance of the season was marked by a number of light rains punctuated every so often by a short intense rain, and the season ended with a rather violent snowstorm on April 26 which covered the Fern Canyon country with 11 inches of snow.

The variation in precipitation between watersheds is shown in the following table:

Precipitation averages  
Season 1939-40 1/

Watershed	I	28.19
	II	32.54
	III	29.96
	IV	30.92
	V	26.46
	VI	28.79
	VII	26.40
	VIII	25.98
	IX	24.99
	X	26.41
San Dimas Canyon		28.14
Big Dalton Canyon		25.31
Experimental Forest		27.42

1/ To June 1, inclusive

Lysimeters. A partial analysis of the seasonal precipitation, run-off, and seepage to May 9, inclusive, for the large lysimeters, recently completed, reveals some especially interesting facts. Seepage is still taking place, and according to past performance these totals will be increased by about 2 inches during the summer. To date, the run-off average is 56 percent and the seepage average 11 percent — a combined yield of 67 percent of this season's precipitation.

Mention was made in the February-March report of the installation of one-cubic-inch tipping buckets for the purpose of measuring

seepage rates from the large lysimeters. These seepage records when plotted showed very definite semi-diurnal cycles which agree very nicely with the Station barograph record, the peak of the seepage cycle coinciding with the trough of the barograph trace and conversely. The long-time fluctuations in barometric pressure which indicate general pressure movements are also reflected in the gradual increase and decrease of the seepage rate. The seepage-rate curve also shows length of time necessary for rainfall to reach the zone of saturation in the lysimeter soil mass. Additional data are being obtained and will be analyzed in more detail as very interesting results are indicated in the preliminary study.

#### Kings River Branch

Big Creek Watersheds (elevation range 1,000-2,150 feet, woodland-grass type). The 1939-40 accumulated precipitation to May 31 amounted to 31.5 inches -- nearly that of the 1936-37 seasonal precipitation of 33.5 inches, tentatively considered as the normal for this region. Precipitation by seasons beginning with the first (1936-37) is tabulated below, each one of which is expressed in percent of the 1936-37 figure.

Season	Seasonal precipitation <u>Inches</u>	Percent of 1936-37 season
1936-37	33.5	100
1937-38	41.8	125
1938-39	17.3	52
1939-40 1/	31.5	94

1/ To June 1, 1940

During the 1939-40 season precipitation occurred in 21 moderate storms, the maximum of which amounted to 6 inches in the period January 6-12, and the minimum, .02 inch, on December 23, 1939. Run-off throughout the season was relatively low, and preliminary study indicates that the total water production from the area will approximate 15 percent of the seasonal precipitation, as contrasted with about 20 percent for the 1936-37 season, 30 percent for the 1937-38 season, and 5 percent for the 1938-39 season.

Teakettle Creek Watersheds (elevation range 6,500-8,000 feet, pine-fir forest). Fragmentary measurements of snow on the ground and maximum and minimum temperatures were made during 1938-39 at strategic points. These records could be used at a later date for comparison with more complete measurements, and as a guide in planning more detailed studies.

During the 1939-40 season observations were expanded to include the following:

## INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW (Cont'd)

1. Continuous stream gaging stations maintained at mouths of three 500-acre watersheds.
2. Two key snow courses measured semi-monthly.
3. Fourteen snow courses measured monthly.
4. Ground and snow temperatures continuously recorded at a single station.
5. Rainfall and snowfall measured in shielded and unshielded standard Weather Bureau gages.
6. Maximum and minimum air temperatures, wind velocity, and humidity measured at a single station.

Summaries of key snow-course measurements for the 1939-40 season to April 30, 1940, are tabulated in the following table along with the fragmentary data collected during the 1938-39 season. Normally, little or no melting of snow would be expected before April 1, but as the table indicates there was considerable melting this year between March 15 and April 6.

## INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW (Cont'd)

Key snow-course measurements  
Teakettle Creek watersheds  
1938-39 and 1939-40

Date	Elevation 6,700				Elevation 7,670			
	1938-39		1939-40		1938-39		1939-40	
	Water content	Density Inches	Depth content	Water content	Density Inches	Water content	Density	
1-14		28.8	11.4	40		25.2	11.1	
2-5		34.6	13.9	40		67.0	23.3	
2-20		46.1	15.2	33		63.3	18.3	
3-15		55.0	26.1	48		98.1	38.7	
4-6		48.3	19.7	41		86.2	34.0	
4-18	12.7	6.7	53		28.1	13.3		
4-25	4.3	2.1	49	34.3	18.9	47		
5-4	No snow on course					60.8	22.6	
							37	

Southwestern

Improvements to time recorder system. During the past 8 months considerable attention has been given to improvement of the time recorder system on the Sierra Ancha Experimental Forest. Time recorders heretofore installed at the Base Rock Lysimeters and the Upper Pocket Creek Dam have been moved to the Parker Creek Station office building. This change will result in a substantial saving of station personnel time and eliminate travel to and from the Station and these outlying points during storm periods. All recording rain gages on Upper Parker and Upper Pocket Creek watersheds will now be connected with a single time recorder. Disposition of the 5 recording gages located on each of the two troughlike canyon drainages is as follows: One gage is located in the canyon bottom; the other four are located at medium and high elevations on north and south exposures. With this arrangement the average intensity of catch at the 5 gages is expected to give a reasonably accurate measurement of rainfall intensity over the entire area of each watershed.

Intensity of rainfall and rate of run-off at the Base Rock Lysimeters and the Natural Drainage Areas and rate of percolation at the Base Rock Lysimeters will be recorded on a second time recorder. The third recorder will be connected with recording apparatus at the Steep Slope Run-off Plots and batteries of small lysimeters. Approximately 10 miles of No. 9 copper wire and 60 miles of No. 12 iron wire were used in the construction of new lines connecting the Upper Pocket Creek Dam and the Natural Drainages with the recorders at the Parker Creek Station.

Installation of new equipment. Two intensity precipitation recorders are to be installed on the Workman Creek experimental watershed in time to catch the summer readings. One of these gages is to be located in the center of the saucer-shaped basin of 1,087 acres at an elevation of about 6,800 feet. The other will be located approximately 1,000 feet higher in country representative of the highest portion of Sierra Ancha. It is expected that the average annual rainfall at this Station will be in excess of 30 inches.

San Dimas type millipoint water-level indicators are being installed at two streamflow measuring stations.

Additional water-stage recorders are being installed at Upper Pocket Creek Dam and at the lower dams in Parker and Pocket Creeks. Those are for measurement of high flows during flood stages when flow might exceed capacity of present measuring devices.

Vegetation survey. A start will be made on measurement of vegetation cover on Natural Drainages and Pocket Creek experimental

watershed areas during the coming summer with the aid of student help. Areas will be gridironed in sufficient detail to enable the mapper to spot in types and subtypes of vegetation. Density and composition of cover will be measured according to the line-transect method developed by Canfield of the Southwestern Station.

### RANGE RESEARCH

#### ARTIFICIAL REVEGETATION

##### California

Species. A number of plants were added this year to those being tested in the forage plant nursery at the San Joaquin Experimental Range. The greatest single collection included seed of 25 different alfalfas from many parts of the world, furnished by the Bureau of Plant Industry. Some of these are showing sufficient promise to warrant further testing.

Some creeping-rooted alfalfa plants set out last summer have shown exceptional promise; all 10 plants put out survived the summer with but little water. Over 2,500 cuttings made last winter have now been transplanted. It was found that cuttings of this plant can be made very easily, only a single joint being needed to produce a root and shoot. When a single leaf was planted, roots developed normally, but shoots have thus far failed to develop in such cases. The large number of plants set out this spring are making a rapid growth at present and appear to be withstanding the drought exceptionally well.

Subterranean clover, which has done well during the three previous seasons, showed up even better this year. Some of the runners produced were 30 inches long and a heavy bur crop developed. Several different strains are being tested, some of which are distinctly better adapted to our foothill conditions than others. Of two stockmen in the community who planted small plots to subterranean clover last fall, one grew an excellent crop while the other had no success at all.

Rye grass (Lolium rigidum var. strictum) has shown the most promise of the annual grasses tested. This grass has been tried out during the last two years and has done considerably better than the ordinary annual rye grass (Lolium subulatum). The latter, planted in test plots out on the range in 1937, has reseeded itself each year since, although the stand has gradually decreased in density each year. Lolium rigidum var. strictum was planted in test plots out on the range for the first time last fall and an excellent crop and many seed were produced.

Of the perennial grasses being tested, smilo (Oryzopsis miliacea) continues to do better than any of the others, although it has some difficulty in surviving the hot dry summers. This grass usually produces a heavy seed crop, and in the nursery many new plants have come up. However, it is known that the seed of this grass usually germinate poorly.

Several plants of saltbush (Atriplex) transplanted in field plots last spring illustrate one of the difficulties of this type of study. The young plants usually have great difficulty in getting started since they seem to be a favorite food of rabbits, ground squirrels, birds, pocket gophers, and kangaroo rats, all of which are plentiful on the area.

### Intermountain

#### General

##### Opportunities of Supplementing Range Forage With Spring-Fall Pastures.

Great opportunities in the Intermountain region have been found to exist for supplementing range forage by developing pasturage for early spring and late fall use. Originally seasonal range suited for early spring use was short in proportion to that suited for summer and winter grazing. This shortage was further accentuated by the fact that all cultivated land in the region was taken from original spring range. Moreover, as settlements developed, all in the zone of spring-fall grazing, those ranges adjacent to settlements were used most continuously and severely. The plowing out and subsequent abandonment of large areas for tillage, when combined with severe and long grazing use, has made extremely acute the need for more feed than the spring ranges produce.

Not only is the need for additional pastures for range livestock very great but research studies have shown that certain plant species are suitable for seeding on available pasture lands, of which there is a considerable acreage. Some of these lands lie on present farms partly in odd corners but largely on compact areas for which there is insufficient water to produce ordinary cultivated crops. Other and larger areas lie on lands now abandoned to tillage but still suitable for pastures, and also on valley and gently sloping foothill ranges where the plant cover has deteriorated since settlement.

In spite of a proverbial scarcity of water in the region, much spring flood water is unused and also run-off from occasional heavy storms. The State Engineer of Utah reports that eventually a large number of small reservoirs will be constructed and turn flood waters into a season-long supply. Until this is done, and in some cases

after it is done, these waters not now available for tilled crops are highly valuable for drought-enduring grasses. Unlike most farm crops, properly chosen grasses respond well to one or two flood-water irrigations. Even though they would do better with fuller irrigation, the recommended species grow rapidly early in the season and therefore use early water advantageously.

Practically all these lands where irrigation is possible, at least at occasional intervals, lie in upper valley edges at elevations of from 4,500 to 6,500 feet. In the lower hotter parts of this zone crested wheatgrass has given the best results. In slightly cooler and moister areas slender wheatgrass and crested wheatgrass both succeed when given a favorable opportunity. Bulbous bluegrass also has promise as a secondary member of a mixture with either slender or crested wheatgrass, but for pasture it is not suitable by itself. It starts growth very early and dries up completely during summer. With two dependable irrigations smooth bromegrass will likely outyield the species named.

Areas much more extensive than those that can be irrigated by flood waters have good possibilities for dry-farm pastures. Most of the abandoned lands had originally deep productive soil, now somewhat deteriorated as a result of wind and water erosion, but which are still capable of profitably producing grass forages. Some of the range lands above the farming zone, and some in the farming zone, will yield profitable returns by seeding between bushes, or after removing sagebrush or other shrubs. Whether plowing will pay for the extra labor will depend on the soil, the moisture supply and the importance of the particular area to the operator's general set-up.

On low, hot dry-land crested wheatgrass has been best, with possibly a little bulbous bluegrass as a secondary mixture. At 6,000 feet and above, slender wheatgrass, mixed with the others will probably increase the yield. When the aspen zone is approached some smooth bromegrass and mountain brome may well be added to the mixture. When established in this zone these grasses have yielded 2 to 5 times as much forage as is produced on ordinary native range.

Starting these grasses, however, is no easy task. It has to be done at the right time and in the right way. Experimental data establish clearly that seed must be covered with from one-fourth inch to  $1\frac{1}{2}$  inches of soil by drilling, harrowing, or dragging. On the average fall seeding has proved to be most frequently successful. In unusually dry seasons, or even in seasons with nearly normal total precipitation that have protracted hot, dry springs, seedlings are likely to die even after successful germination stands are obtained. Seeding requires the utmost care.

MethodsCutting of Wild Rose and Western Virgins-Bower Respond

Favorably to Hormone Treatment. Preliminary tests made in the greenhouse during the past winter show that spring cuttings made from wild rose (*Rosa fendleri*) and western virgins-bower (*Clematis ligustifolia*) possess good rooting qualities when treated with indole acetic acid. However, the control cuttings of wild rose were almost equally as well rooted as the treated cuttings. In contrast to this, it was definitely shown that the treated cuttings of *Clematis* when compared to the control had a greater percentage of rooted cuttings as well as more and longer roots.

In this study nine native shrubby species were selected to test the effect that indole acetic acid would have on the rooting of stem cuttings made from these species in early spring. The treatment consisted of three acid concentrations (200, 300, and 400 mg. per liter) and a control. After treatment the cuttings were placed in a rooting medium of coarse, moist sand where they remained until a subsequent examination was made.

Although a significant difference is visible between the control and the hormone treated cuttings of *Clematis* the differences between the acid concentrations requires statistical analysis. The response of the control cuttings of wild rose with regard to the treated material is a reversal of a previous study which provided for the cuttings to be made in the fall. Evidently the physiological status of this plant is more conducive to the rooting of cuttings made in early spring than in the fall. Of the remaining species some indications of significant differences were seen but the number of rooted cuttings per species was too low to be of any immediate practical value.

The response of wild rose and western virgins-bower in this study connotes the practicability of their use in revegetating areas not readily adapted to actual seeding. Furthermore, species having seeds of low viability or which possess unfavorable germinating qualities for revegetation may yield to this method of propagation. Trials with cuttings under field conditions will be conducted during the forthcoming spring.

Site FactorsEarly Spring Rainfall Benefits Stands of Fall-Seeded Grass.

Throughout most of the Intermountain region the fall of 1939 was not conducive to good seedling growth of grasses. Precipitation during November was less than half normal, being in some cases but 15 percent of normal. Species seeded in the early fall, which normally germinate soon after planting, did not germinate until the

spring of 1940. Because of this delayed germination seedlings did not have a chance to stool and develop root systems as they do in ordinary years. With the exception of southern Utah early spring precipitation was above average. Wherever this timely, abundant precipitation occurred a good germination and seedling establishment resulted. Late spring precipitation was above average in central Utah, but at other locations there was little precipitation during this period. Because of this late spring dry period most seedlings are small--averaging about 2 inches in height, and nearly all in the 2 or 3 leaf stage. Considerable seedling mortality during the dry summer months is expected but it is likely that enough seedlings will endure the summer drought to make a successful stand.

In northern Nevada there was some fall germination on plantings made in early October. In a newly plowed experimental area practically all of the seedlings were heaved out of the ground by frost action, but plantings made on undisturbed ground are doing well.

Exceptionally good stands of seedlings have been secured in western Idaho. To date there has been little mortality and the seedlings are going into dormancy and apparently will survive the summer drought and produce good stands.

The spring growing season in eastern Idaho has been favorable. Seedlings are small but inasmuch as they are vigorously growing in the bottom of deep drill furrows, it is expected that they will endure the summer drought. Older plantings will probably produce a good seed crop this year. Where the soil was greatly disturbed by cultural operations, it packed and formed a crust that greatly hindered emergence of slow germinating species. This was especially true in southeastern Idaho.

In northern Utah seedlings of many species have already succumbed to the late spring drought but it looks as if the better adapted species will endure the summer drought and produce good stands. The best growth has been on areas having light-textured soils.

In central Utah, at an elevation of 5,600 feet, in the vicinity of Ephraim, spring moisture and temperature conditions have been highly favorable for germination and continued development of 1939 fall plantings. Seedlings are from 4 to 10 inches high and many species are stooling. Considering the normal dryness of the site, seedlings in this section would be classed as exceptionally good. Cutworm infestation has materially reduced the stand of wood and shrub seedlings. This is the first known instance in this region where cutworms have presented themselves as a problem in range revegetation.

Owing to the dry spring in southwestern Utah, experimental plantings made at the Desert Range Branch Station and near Cedar City during the

fall of 1939 failed to make good showings. Excavations of seeds revealed that there had been enough early spring moisture in the ground to germinate seeds but supplementary precipitation was not adequate to keep the sprouting seeds alive. Two-year-old stands of crested wheatgrass that were growing vigorously a year ago appeared stunted and partly dormant from lack of moisture.

### Southwestern

#### Species

Seedling development of a range forage plant. Because of the generally adverse climatic conditions, seedling establishment by the important perennial forage grasses is very erratic on the ranges of southern Arizona. To a large extent the maintenance of good grassland ranges is dependent upon successful reproduction by seed and in the improvement of depleted grass stands this process is of even greater significance.

Of the various grasses tested by this Station in artificial revegetation trials, one species, namely, tanglehead (Heteropogon contortus) has been consistently unique in its ability to become established on deteriorated sites despite unfavorable climatic conditions. Results of seeding tests with tanglehead have been previously reported in Research Notes Nos. 7, 37, and 61 of this Station.

Recently studies of the early processes of seedling development of this grass were conducted under range conditions on the Santa Rita Experimental Range and under partially controlled conditions in a greenhouse at the University of Arizona. In the studies more than 1,000 seedlings grown on a field test plot and later in pots in the laboratory were excavated, examined, and measured. On the field plot the plants grew under natural rainfall and soil conditions during the summer of 1938 while in the greenhouse the plants were grown in a prepared soil under four different frequencies of irrigation and three intensities of competition during the winter and spring of 1939. In both cases, growing conditions were determined by measurements of soil moisture, air and soil temperatures, relative humidity, and solar radiation.

The results obtained from those studies may be summarized as follows:

1. The seedlings exhibited a very slow rate of growth as compared to Sudan grass and other cultivated grasses.

2. Root development was confined to the normal zone of moisture penetration, i.e., 6 inches.
3. Adventitious roots are initiated within 12 to 15 days after emergence of the shoots provided that moisture is available at the soil surface for a period of 3 days or more, but where surface moisture is lacking, the seedlings may make almost normal growth during the first growing season with only the primary root system.
4. Tillering of the shoots and disintegration of the primary root system was closely associated with initiation of adventitious roots.
5. Length of roots was inversely proportional to the amount of water available and to the intensity of competition.
6. Size of shoots and ratio of shoots to roots varied directly with soil moisture and inversely with degree of competition.
7. Five-week-old seedlings subjected to drought periods of 6 and 11 weeks greened up within 48 hours after being watered, indicating that this plant can stand considerable desiccation without permanent injury.

#### GRAZING MANAGEMENT

##### Northern Rocky Mountain

###### Sierra Ranges

Range Survey Methods Study. Results of the comparison of range survey methods indicate that forage estimates made by the reconnaissance method of sampling vegetation and by using aerial photographs for determining boundaries of forage types are more uniform than those made by the other survey procedures studied. Comparisons between the survey procedures were made on the basis of an administrative range survey project where several men work together as a crew, each field examiner surveying different parts of the range. The data indicate that forage estimates made by the reconnaissance method using aerial photographs can be expected to be within an accuracy of 13 percent on a single section, 7.5 percent on an area 3 sections in size, and 4.4 percent on an area

9 sections in size. On the same basis, estimates of forage on a single section made by the reconnaissance method but sketching the boundaries between forage types (grid, strip-mapping procedure) can be expected to be within an accuracy of 15 percent. Similarly, forage estimates made by the square-foot-density method on an area of one section can be expected to be within an accuracy of 15.8 percent when the forage is sampled by types using aerial photographs (average of 36 plots per section) and 23.6 percent when grid or strip procedure is employed (20 plots per section).

The main weakness of the reconnaissance method was shown to be that the write-up of the forage on each type was not always representative of all the forage on the type. Therefore, when using the reconnaissance method, emphasis should be placed on a thorough examination of each type and of preparing several write-ups, if possible. The weaknesses of the square-foot-density method were that the field examiners did not get together as well in their density estimates as with the reconnaissance method and that the method had a large experimental error in sampling the vegetation on the plot. Therefore, when employing the square-foot-density method on range surveys, training the field examiners to estimate plant densities on the plots so as to minimize these weaknesses cannot be over emphasized.

#### COOPERATING BUREAU PROJECTS

##### BIOLOGY

(In cooperation with the Fish and Wildlife Service)

##### California

Wildlife Inventory. A preliminary size-up of the problems relative to a large deer population is being made by Bartholomew, who has previously been engaged in similar work on Los Padres National Forest. Questions being considered include a census of the population, seasonal movement, predation, evidence of deer browsing on the chaparral and stream bottom vegetation, notes on the population as to age classes, especially for comparison with areas without the boundaries of the game refuge, and observations on other problems relative to deer management in chaparral areas. The survey is being carried on in cooperation with the Division of Wildlife and Range Management of the Regional Office under the direction of F. P. Cronmiller, and on certain phases, particularly predation, with the Fish and Wildlife Service, Dept. of the Interior, represented by E. E. Horn.

ENTOMOLOGY

(In cooperation with the Bureau of Entomology and Plant Quarantine)

Appalachian

Chemical Tests for Wood Preservation. On the Santee Experimental Forest healthy loblolly pines ranging in diameter from 11 to 18 inches, were treated in April with several promising wood-preserving salts.

In May 378 sections from poles and trees impregnated with chemicals were set out for service tests on the Santee and equal numbers of sections having the same treatment were sent for testing to the Harrison Experimental Forest in Mississippi and to the Research Center at Beltsville, Md.

Chemical Tests for Insect Control. Sprays were applied to black locust trees in April before leaves were formed to find out whether or not any of the chemicals used could be applied without killing the trees. Black locusts sprayed with similar chemicals in the fall of 1938 were killed.

California

A large portion of the insect collection made by J. T. Wright in the summer of 1938 has been identified and mounted by the Forest Insect Laboratory in Berkeley under the direction of J. M. Miller. The collection includes about 400 specimens.

Southern

Christian at Tallulah, La., has discovered that sodium fluoride and sulphur solutions and, to a less extent, borax and the dinitro compounds are toxic to adult Lyctus powder-post beetles when the chemicals are used as a treatment for wood. A 1% dip of fine particles of sulphur in water (at 190° F.) paralyzes the ovipositor of the beetles and prevents their egg laying. Sulphur is not very effective in preventing sap stain but is a much cheaper dip than borax (5 - 8¢ per thousand feet compared to borax at 18-½). See Southern Lumberman, page 24, May 1, 1940. Whether this chemical will remain on the lumber exposed in piles in the yard has not yet been determined. On April 28th, approximately 4,000 board feet of sulphur-dipped sap pecan lumber was piled in the yard for observation; no infestation has as yet occurred. Borax solutions, while only slightly toxic to the adult beetles, kill the young larvae immediately after hatching, and hence deep penetration within the wood is essential for control. Seven hundred thousand board foot of ash lumber

dipped in a 5% borax solution at 130° F. has been piled in the yard since last spring without infestation. Possibly combinations of hot borax and sulphur dips will prove most effective and cheapest; such mixtures show favorable preliminary results.

Three hundred and seventy-eight 2-foot sections of chemically impregnated shortleaf pine and yellow poplar trees and posts treated by the medication method have been received from Asheville, N. C., and will be placed in the ground for service tests during June, 1940. Both ends of each section will be treated with coal-tar creosote before placing them in the ground.

PATHOLOGY

(In cooperation with the Bureau of Plant Industry)

Appalachian

Plantation Disease Investigations. An extensive study of disease in southern pine plantations was started. Plots of 50 trees each have been staked out in 20 plantations set out this year in the Piedmont and Coastal Plain. The trees on these plots will be examined periodically for an indefinite number of years. In addition to obtaining direct information on the development and effects of the many diseases that affect southern pine, rather complete soil data are being taken at the time of establishment and the changes in soil and ground cover will be followed. It is hoped that eventually more than 100 such plots will be established in the Carolinas and Virginia. Such a large number of plots will make possible a fairly effective sampling of southern pine plantations in these states. The results of this work will not only provide information on disease and growth, but should lead to a better understanding of the soil changes that take place with the development of pine plantations on different types of land.

Mimosa Wilt. Last fall mimosa seed was collected from 40 localities ranging from Washington, D. C., to the Gulf of Mexico. Seedlings were raised in the greenhouse over the winter, and these have been inoculated this spring with the wilt fungus. This work is an attempt to find out if wilt-resistant lines of the mimosa tree exist in the South. While the sampling is inadequate, it is fairly representative of the mimosa-growing area. Two other species of Albizia, A. kalkora, a white-flowered tree, and A. thorelli, a new Asiatic importation, and also A. julibrissin roscom, a hardy form, and catalpa, are also being tested for resistance.

The Fusaria causing wilts of cotton, tobacco, and tomatoes are also being tested on the mimosa tree.

Sugar Maple Disease. Sugar maples have been inoculated with the blue-stain fungus, Endeconidiophora coeruleascens, isolated from dying sugar maples on the Pisgah National Forest last fall, in an attempt to discover the cause of the mortality.

Southern

The little-leaf disease of pines. In connection with a study of the pathological aspects of the little-leaf disease of pines, 21 isolates have been obtained from rootlets, from shallow cortical lesions of large roots and from wood tissue at the root crowns of healthy and diseased pine trees. Of the 21 isolates, 13 classified into four groups on the basis of cultural characters have appeared more than once in culture. A representative collection of these fungi has been assembled on pine roots, puffed wheat, and other sterilized media for outdoor inoculation tests in areas where the little-leaf disease occurs.

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